JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

MARCH, 1850.

CIVIL ENGINEERING.

*American Engineering.—Locomotives.**

[It is only by collecting and comparing what has been done in various countries, that perfection, or anything approaching thereto, is at all attainable in any profession. Different circumstances and localities develop each one its own peculiarities; and to these primary causes is to be added the effect of the application of numerous and varied mental powers in concentration upon one subject. We make these remarks as an introduction for the present article on American locomotives, by Mr. Passavant, formerly of Bradford, the author of the two practically valuable contributions to this Journal, "On the Construction of Locomotive Engines," given at pages 76 and 99, *ante*. Since the date of the appearance of these articles, the author, now of New York, has had the opportunity of visiting and examining the working arrangements of a number of the great lines of the Eastern and Northern States of America; and it is perhaps scarcely necessary for us to urge, that observations conducted there under the eyes of an engineer of Mr. Passavant's previous experience in this country, may be turned to good account by all who are interested in the important details of construction of which he treats. The American locomotive is little known in this country, at least its details are but vaguely understood; probably Mr. Passavant, whom we shall now leave to conduct his own case, will be successful in his endeavors to add to our stock of information upon it.]

In the course of the pages, which are here to be devoted to the elucidation of this important branch of American engineering, many reasons will appear for a frequent expression of a favorable opinion upon the loco-

* From the Glasgow Practical Mechanic's Journal, for January, 1850.

motives of the country, chiefly, however, in reference to the principles upon which they are constructed. In an enumeration of the many engine-builders here, there are several to be found that turn out but rough-looking work. Often, where engines have to be rebuilt at the railroad companies' workshops, more care and better workmanship are there bestowed upon them than in the shops of the original builders; but generally they lack that beautiful glossy finish, and general elegance of design, which distinguish the English locomotives above all others. The engines from some of the larger workshops form splendid exceptions to this statement.

In thus judging, however, from outward look, we must not forget those circumstances which, on railroads here, dictate economy more severely than in England, and that the materials and, above all, labor are very dear. And generally, rough as some of the engines may appear at first sight, it is to be remembered that they are made for hard, rough usage and heavy work, whilst certain leading and excellent principles of construction are found in all, some of which it would be well to adopt in the English workshops. In explanation of these principles, illustrations will be taken from existing engines; and although there may be among these examples some that are not peculiarly commendable—for instance, among the various constructions of frames—there will be one showing the principle which guided the design, although the manner of carrying it out might, with advantage, have been widely different.

Two engines running on different lines, by different makers, I shall introduce with plans of their construction, and compare them with engines of similar power on English roads, as being very good specimens of perhaps—at least so far as I have seen—the best American locomotives. One of them is certainly the most steady-going engine I have ever been on, either here or in Europe. One is a goods engine, on a broad gauge—6 feet—line, with inside cylinders; the other is a narrow gauge engine, with outside connexions. Both these, and examples of other engines, are such as I have gathered myself, and the working of which I have personally observed.

The general construction of an engine is naturally modified by the circumstances under which it is to be used. The usual English passenger engine, with its driving-wheels underneath the centre of gravity, or nearly so, can be employed with considerable profit only on a line nearly level. In ascending gradients, though but slight and of short length, the power which the engine has to exert, and for which it must be constructed, bears a most unreasonable proportion to that necessary for the propulsion of the same train on more favorable sections. In no country has the principle of making the railroad as nearly level and straight as, without most inordinate expenditure, was possible, been carried to the same extreme as in England. The engine is of the kind which works with advantage on a level road; the road was constructed to suit the engine.

This has led to enormous sums of money being laid out on levelling hills, on forming tunnels, on deep cuttings, and high and long viaducts. Still gradients and curves cannot always be avoided. Heavy and powerful engines were built, the same principle being adhered to, with the main weight resting on one pair of drivers placed in the centre, the tractive power being obtained by one pair of wheels only. As the engines in-

creased in weight, rails and substructure had to be increased in strength; but the proportion between the weight of engine, or dead weight, and the weight of train, or paying weight, decreased. Where the gradient does not allow of the usual average velocity—where the engine has to climb up with difficulty, and slowly, even in fair weather—how much more in wet, rain, snow, and fog—it must afterwards run at a fearful rate, for which the builders scarcely designed her, to make up for lost time, to the injury of the machinery, the carriages, and the permanent way.

On the continent of Europe economy was more considered in the construction of railways; and gradients and curves have been employed, on many lines, more severe than those in England. The same style of engine, however, is employed, but the speed, generally, is slower.

In America economy and rapidity of construction were of still greater importance. The face of the country is, perhaps, not more unfavorable than in England; but the distances between populous towns is greater, and the roads have often to pass through large tracts of land which are but thinly peopled; therefore, whatever traffic might be created by increased facilities of communication, the same amount of traffic per mile, or per 100 miles, could not, in the first instance, be calculated on, as in England. The lines are laid along the natural undulations of the country; and, where practicable, large and expensive works are avoided. Thus we see lines passing through valleys, and following all the windings of large rivers, as the Hudson River Road, along the Hudson—the New York and Erie Road, along the Delaware and Susquehanna, and many others; going round hills rather than right through by tunnels, where this would entail more expense. The consequences are, heavy grades and sharp curves.

Such engines as were originally imported from England, adapted to the English lines—which, in the infancy of railway engineering, were made more easy than within the last seven or eight years—failed on the American lines; or better, the duty they performed, that is, the profitable paying duty, bore no just proportion to their absolute power. It was soon perceived, that to import or implicitly copy English engines would be ruinous to the pecuniary interests of the roads, except the English style of building the roads were also adopted.

The ever active, designing, and inventive spirit of the Americans was roused to build an engine to suit their roads. Experiments were made, and gradually certain principles were developed, which are now universally adopted, and enable the engines to go over arduous heavy lines with a speed equal to that used in England, and with equally heavy trains. Some of these principles would add considerably to the durability and effective power of an English engine; but the latter, as it now is made, would be of very little use on roads in this country.

The American engine I mention in the first paper, was one built by Norris of Philadelphia, about six or seven years ago, and is of a class then much used here—small and light; a truck with four small wheels in front, one pair of $4\frac{1}{2}$ feet driving-wheels in front of the fire-box, and outside cylinders. The peculiar style of American roads demands as light an engine as it is possible to make with a given power. Since that time, however, the system has been very much changed; eight-wheeled engines are very

general, and even many ten-wheeled are used. Of both classes I shall give illustrations.

Before leaving these general remarks, I will state, *en passant*, one particular which, in comparing the work done by an English and American engine, should be taken notice of. To determine the effect of the resistance of the atmosphere in retarding the speed or absorbing the power of an engine, many experiments have lately been made. One thing is certain, that extent of surface exposed against the current determines, at equal speeds, the amount of pressure. Here the American engines labor under a manifest disadvantage. Wood being the fuel used, they are obliged to carry a high, large, top-heavy chimney, with a cumbrous spark-catcher, very different from the small, slight chimney of an English engine. It acts against the engine, not only by its size, but also by the great leverage the heaviest part—the top—has from the centre line of the whole machine.

THE FRAME—AN INQUIRY INTO THE PRINCIPLES OF ITS STABILITY.

I premise here, that when I use the term "frame," I allude to the frame-beam, bar, or plate, on one side only; and when speaking of the two sides together, with their transverse connexions, as *one* structure, I shall use the term "framing."

The first great alteration, and attempt to depart in any important point from the English construction, was made in altering one of Stephenson's engines, in 1833, I believe, by substituting for the leading axle the truck-frame, still almost universally used: that is, two axles were placed close together in one frame, separate and independent from the engine. This truck bears the front part of the engine, supporting its frame, and is movable round a pin, under the centre of the smoke-box. On passing through a curve, the wheels adjust themselves to it; and the great strain and friction of the flanches against the rails, and of the axles in their bearings, is thus relieved. If the centre driving-wheels, as generally is the case, have no flanches on their tyre, there is, in a curve, but little friction against the side of the rail, and none that can exercise an injurious effect on the machinery; besides, the danger of getting out of the track in switches, &c., is entirely avoided. With the introduction of this truck, the engine was at once enabled to pass, with perfect ease and safety, and at its highest speed, through curves on the main track, such as, in Europe, would be considered hardly safe even in sidings at stations.

The next alteration of great importance was the substitution of a straight axle for the cranked axle, placing the cylinders outside the frame, letting the axles run in inside bearings. This, with the truck, completely changed the character of the locomotive.

The same genius which thus altered, perceived the necessity for a framing more rigid than the usual one, and an entirely new construction was introduced, possessing great lateral stiffness.

Why was this necessary? On outside cylinder engines being built in England, instead of a stronger, a much weaker framing was used. There, engines with inside cylinders have always been constructed with two frames on each side; one only carries, but the second one contributes greatly to the lateral stiffness of the whole. That it is not necessary, is proved by

many such engines being constructed and successfully worked in this country, with only one frame, with inside bearings. On the cylinders being placed outside, the engines were found to oscillate much more. To resist or prevent this oscillation, the only way was to stiffen the engine laterally. This was the object of the new American frame. What was done in England to oppose this injurious tendency?

It is not, perhaps, out of place here to explain, not what the oscillation of an engine is—that is well known—but what circumstances cause and produce it; for if that had been well understood, the slight plate frame would not have been generally introduced for this class of engine.

The framing consists of two beams; or rather, it is a structure which has not only to carry a weight in a vertical direction, but is at the same time acted upon by forces against its sides in a lateral direction. In constructing it, we must take into account, and admit into the calculation, the whole duty it has to perform, and so proportion its strength. We must inquire into all the forces which act against it in various directions, and seek to disturb its equilibrium; the same as we should in constructing any bridge-girder or roof-truss. To carry vertically, it must possess depth according to the amount of superincumbent weight. To oppose lateral forces it must have breadth: that is, depth in the direction of the forces, to give it stiffness or rigidity.

What are these lateral forces? The rails cannot be laid in, or made to preserve, a straight even line along their sides, therefore the wheels may not be made to fit in tight between the rails. Whatever speed, consequently, the engine may go at in a straight line, but much more so in a curve, the front wheels, and hence the whole engine, will be forced over from one side of the track to the other. Reference is made in page 117, Vol. II. of this Journal, to the lateral pressure which the rails, from this cause, have to sustain. Where a pressure is sustained, there must be power to produce it; and where a power meets with resistance, a reaction is produced. This reaction on the part of the rails is experienced by the engine, which, by it, is made to roll over on the other side of the track; thence it rebounds, and thus—lateral play being always left in the bearings, to prevent the straining of the axles in curves—the bearings, and, from them, the frame, receives a succession of small shocks. These act upon the frame-plate with a leverage equal to the distance from the point of application—the wheel-centre—to the line of the centre of gravity, or, better, the neutral axis of the frame. Small as the shocks are at first, a new shock, or application of the force, being added before the effect of the former has ceased, they gradually produce, by their great leverage, a trembling or vibration of the frame-plate; which, if it be not laterally rigid enough to oppose the force, constantly increases. If we consider,—1st, that this trembling gradually spreads throughout the whole frame; 2d, where weight hangs, on its partaking of the motion, the momentum of the force is considerably increased; 3d, where there is no stiff connexion with the other side of the engine, giving great depth or support to the beam laterally, the motion is the greatest; 4th, in the English outside cylinder engine, the great weight of the cylinder and steam chests overhangs the point of vertical support, and has only a very trifling transverse stiffening; and 5th, at the leading axle the shocks are first received, and first imparted to the

frame, where the transverse connexion is far less rigid than at the back part of the engine,—we shall not be surprised to hear of such engines being exposed to very great oscillation; to more wear and tear, and resistance from strains; to greater injury of the permanent way—for the less the means of resisting the oscillation, the more will be its amount, and therefore the pressures against the sides of the rails increases; and, at very high speeds, on entering or leaving a curve, even to the danger of fairly swinging off the track.

The rolling motion of the engine cannot be avoided; but the tremulous one, the primary cause of such evil consequences, may, by judicious construction, be most successfully resisted. If we suppose a solid plate fixed in between the two frames, extending from this point to the fire-box, or, instead of that, the two trussed together like a bridge-truss, the motion imparted to any one point of the frame would be equally distributed throughout the whole structure, and the distance between the two would be the depth of the beam, resisting lateral pressure. Such a construction would, however, not only be very inconvenient, but it would produce a strength infinitely greater than is necessary. We will examine, therefore, whether there is not a way of attaining the requisite rigidity of frame without such trussing.

On comparison, we shall find some points of material difference in the constructions of the English and American framing.

For the sake of comparison, I shall take two engines, an English and an American one, both only lately constructed, and which may be considered very good examples of their respective classes. Both are outside cylinder engines, on narrow gauge lines; one is the outside cylinder engine, by Messrs. Sharp, Brothers & Co., (1848) of Manchester; (several engines have before been constructed by the same firm, very similar in general design, but without the tank;) and the other is the "Mohawk," outside cylinder, passenger and freight engine, on the Albany and Schenectady Railroad, N. Y., as rebuilt at the company's workshop in Albany, according to the designs, and under the superintendence, of their able engineer, Mr. McQueen, (now of the Hudson River Railroad,) and is an exceedingly powerful and steady engine. These two are tolerably well matched for comparison. No. 1—the English Engine—has 15-inch cylinders, and 20-inch stroke; No. 2 has 15-inch cylinders, and 25-inch stroke. One has 5½-feet drivers, the other 5-feet; both boilers are 3 feet 6 inches diameter, the English tubes being 10 feet 7¾ inches long; those of No. 2, 11 feet 10 inches. A sketch of these two engines, as placed in comparison, is appended to this article,* to which the reader is here referred; from this another advantage of No. 2 will be noticed, viz., the centre of its boiler is 4 feet 11½ inches; in No. 2, 5 feet 7 inches above the rails, being—making allowance for the extra size of driving-wheels—3½ inches in favor of the former.

In engine No. 1—the English engine—the two frame-plates carry the whole weight; and, always taking the centre of gravity as the point where a force or weight is applied, the cylinders, steam-chests, smoke-box, and chimney, overhang the point of support by upwards of 3 feet. In No. 2, the frame-plates are, in front, themselves carried by the truck-frame, the

* And will appear in our next number.

vertical strain upon them being therefore less; and this support is placed underneath, or very near, the centre of the cylinders. Overhanging weight there is none, excepting the buffer-plank, with its appendages, which are certainly heavier than in No. 1; but their leverage distance from the point of support is smaller, and they are carried by a strong stay-rod. This tendency to oscillation is, therefore, removed. We find, moreover, in No. 1, a rigid leading axle, unavoidably subject to straining in curves, and one cause of oscillation. In No. 2, we find the truck movable round a centre pin, the wheels and axles easily adjusting themselves to the curvature—thus removing a great cause of wear and tear, and loss of power. The buffer-plank of No. 2, which acts as a transverse stay between the two frames, or a support to each against a lateral force, is placed much nearer the cylinders than in No. 1: that is, where, from the suspended weight, the momentum acquired by the vibration is greatest. We find, further, at this very spot, a very strong—both laterally and vertically—cast iron plate fixed in between the two frames, to which the cylinders are attached, a rigid connexion entirely wanting in No. 1, although this is the part where it is most needed. The manner of fixing the cylinders to this plate in No. 2 is undoubtedly firmer than the attachment in No. 1 to the frames; in the former case the bearing surface being broad, and in the latter only one row of bolts are used. Also, the straight plate of wrought iron passing under the boiler-barrel in No. 2, fixed to the frames, and carrying the slide-bars, is a more rigid stiffening, transversely, than the curved plate, which is at the same time a carrier to the boiler in No. 1. Were the form of the frame-beam the same with the above points of difference, we should rightly suppose No. 2 a more steady-going engine. But in the construction of these beams itself, we find a better proportioning of material, to the purpose for which it is designed, in No. 2. Each plate of No. 1, supported as it is, will bear near 100 tons vertically, without injury, if equally distributed along its length, and in a state of rest; but when we consider its lateral rigidity, its power of resistance to a force acting against its sides, the beam is of a length equal to the distance between the fire-box—where the transverse connexion is firmest—to the front buffer-plank, 13 ft. 5 in. broad, 8 in. deep $= \frac{7}{8}$; and its strength to resist $= \frac{(\frac{7}{8})^2 \times 8 \times 5500}{13{\cdot}4} = 2514$ lbs.; or, considering the boiler-stay a sufficiently stiff connexion, the length of beam is reduced to 8·3, and its strength increased to $\frac{(\frac{7}{8})^2 \times 8 \times 5500}{8{\cdot}3} = 4044{\cdot}1$ lbs. The American frame consists of a bar of iron, 2 inches thick × 4 inches broad. The distance from the fire-box to the cast iron plate is 11 feet 5 inches; the strength (laterally) of this beam is $\frac{4^2 \times 2 \times 5500}{11{\cdot}416} = 6{\cdot}8$ tons; and, taking into consideration the cross-stay in the centre, the length of beam is only one-half, its rigidity double. In No. 1, a force equal to 2000 lbs., applied at the centre of this beam, is sufficient to bend it; in No. 2, 4 tons = 8800 lbs. is necessary.* The surplus strength of the English

* Moreover, the force being applied at the centre of the front wheels, it is in No. 1 applied near the centre of the beam; and in the second half is repeated by the driving-wheels having flanches. In No. 2 the power is applied at the end of the beam in the truck; and the driving-wheels have no flanches.

engine in no way contributes to increase the lateral stiffness of the structure; in the American engine it does altogether. The boiler, from its high position, exerts a lateral pressure against the frame; this diminishes the power of every frame to resist an external force. In many English outside cylinder engines there is not even the transverse plate, as in the one here cited; the boiler is carried by stays attached on each side, without such a connexion between them; and the builders trust that the boiler itself will form this connexion. But the very position of the boiler, as soon as the vibration is imparted to it, exposes it to even greater oscillation than the lower part of the engine; instead of steadying the frame, it will increase the momentum of its motion. Engineers will agree with me, that the stability of a structure should not be made to depend on the weight it has to carry; the structure must be strong, if it cannot itself resist all the external forces, in whatever direction they act against it. If that is the case, it alone can be trusted to keep steady a superincumbent weight. Who would trust the strength of a bridge, truss, or arch, where the weight of a train passing over it was necessary to bring all the posts home to their bearings?

Which of these two frames is the most scientific, and at the same time the most practical? Of two engines of equal power, which will produce the greatest useful effect? The one that works most easy, and has least oscillation and strain. Which will have the greater durability, and, therefore, be the more economical? The one which possesses greater steadiness of motion. This engine also works most easy; and it will be the one of most stability—the one best proportioned to meet the forces whose resistance it is opposed to. I leave it to my readers to judge between the two classes of framing.

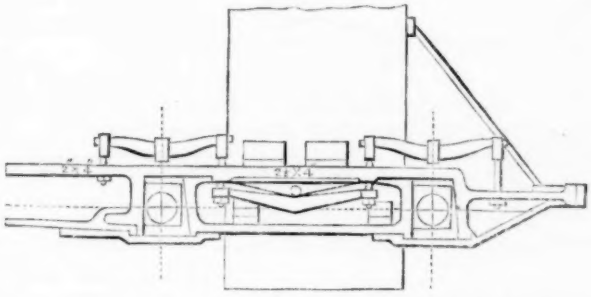
Generally, the inside cylinder engine is far more steady; but the real cause of this superior steadiness seems not to have been rightly investigated, otherwise it would have been so easy to furnish the other class with that principle of construction which was wanting to make it steady. Comparing the two classes of English engines, we are not surprised at the greater stability of the one; but we may be surprised that, the greater oscillation being acknowledged, a construction so bad in theory, and proved by experience so insufficient, should have been retained. Not only does the inner frame of an engine with inside connexions—which, however, in many cases, is not used in America--contribute to and more than double the stiffness of the structure laterally, but the position of the cylinders, and their attachment with one another and with the frame, contribute to it, and, with the cross-plate carrying the slide bars, divide the bearing length of the beam—taking it as above to resist a lateral pressure—into three parts, and increase its rigidity ninefold.

Treating on the stability of the framing, we meet with another principle in the American construction, intimately bearing upon the same subject. It is the same principle which is recognised and acted on in accordance with, in all solid constructions, in all straight and curved girders, and in arches, namely, that all external forces acting on it, tending to destroy its equilibrium, should meet in the line of resistance of such structure, and that this line of resistance should lie within it.

The direction in which the propelling power of an engine acts, is in a

line with the centre of the driving-wheel. This power is transferred through the frame to the couplings and the train. If a line through the centre of the buffers and couplings lie in a level with the line of resistance and centre of driving-wheel, then the pull and resistance being all in the same level, there will be no power lost, nor will straining in the frame be produced through the injurious leverage which the resistance has upon the power, viz., the distance from the level, where the power has to be applied, to where it is exerted, *i. e.* from the line of resistance to the centre of the wheel. BOTH SHOULD FALL WITHIN THE FRAME-BEAM. The height of the couplings always remains the same; but the size of the driving-wheel, and, therefore, the position of its centre, varies very much. In some engines with the plate-frame and large driving-wheels, the plate is so shaped that this object is attained; let us compare, for instance, the two engines of the Great Western Railway, shown in Tredgold. In the "Iron Duke," the centre of the driving-wheel very nearly coincides with the top line of the main frame; while, in the "Pyracmon," the centre lies 9 inches below the lower edge of the frame. The line of resistance being, in both cases, in the centre of the plate, the power, in one case, is much nearer where it is required, and acts, therefore, with greater advantage than in the latter.

Fig. 1.



From this reason, the horn-plates, within which the axle-box rests, are exposed to a great strain, and, when the engine pulls a very heavy train, might be liable to yield. Therefore, the very strong construction of frame was adopted in engines of the Pyracmon class, having, however, the disadvantage of unnecessary weight and waste of material. The general construction of horn-plates—whether cut out of the same sheet with the frame, or riveted on—with the stay-rods between them, to oppose this yielding, is well known.

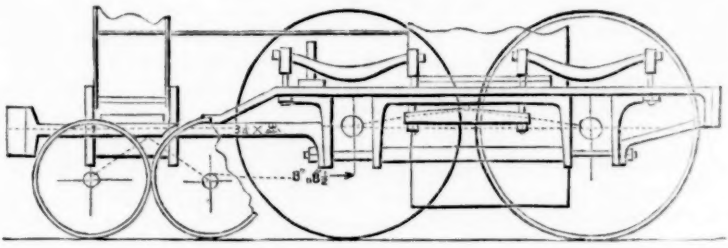
In the examples of American locomotive frames added above, the lower bar, instead of a mere stiffening stay, is as important to the bearing power of the whole as the upper one; in fact, the frame is constructed like a trussed beam, the centre line of which coincides with the centre of the driving-wheel; the back half of the frame, having a great weight to carry, is thus made of great strength; the front half is much weaker, because its true strength, transversely, is not called into action to the same amount.

Of the three examples here given, figs. 1 and 2 are for coupled engines. Fig. 1 shows a frame remarkably strong in all directions; it belongs to an

engine of the class of the "Mohawk," and is designed by the same engineer; it is only partly shown, the part left out, being the same as in the "Mohawk," will be seen in that drawing. Fig. 2 is the frame of an engine by the Springfield Car and Engine Co., and serves to show in what way the principles of construction, detailed above, are carried out by other makers. Fig. 3* is a frame lately constructed on an engine with only one pair of drivers. Much as it varies from the other constructions, it embodies their sound principles, combined with great firmness and rigidity. At first sight, it may appear as if this frame were not a strong or good one, because it consists of two pieces; but the real centre of support is not over the axle, but at the point of suspension of the springs, and over the wheel-centre; it is not the relative strength, that is, the power to resist transverse strain, but the absolute strength, or direct cohesion of the metal, which is called into action. This frame was constructed by the Matteawan Machine Building Company.

A peculiar combination of the springs for the hind wheels will be observed in all these examples. A compensation lever is placed between the two springs, on which rests the weight; the centre of the lever being halfway between the two axles, and to its ends the springs are attached.

Fig. 2.



This arrangement balances the engine beautifully. The pumping motion, its causes and consequences, have been fully described before, and it causes the weight resting on the driving-wheels, and consequently the tractive power, to be subject to constant variation. When, by inequalities in the surface of the road, one pair of wheels would be relieved of part of the weight—which of course would, in the English construction, be thrown on the others—then this lever comes into play, and equalizes the weight between them, so that, whatever position the wheels be in, they have always the same weight resting upon them, and can always exert the same amount of tractive power.

This plan is obviously to be preferred to the construction in an English coupled engine; where, on less weight resting on one pair of wheels by their descending into a hollow on the surface of the rail, a larger proportion of weight is thrown on the other pair; what one pair loses in tractive power, the other has to exert more. A similar object is attained in the 8-wheeled engines on the Great Western Road, and in that of Mr. Crampton on the fore-wheels only; where, they not being drivers, it is of less

* This figure will also be given next month.

consequence in the steadying of the engine, by two wheels having only one spring. But compare the weight and expense of one spring of 6 or 7 and 8 feet long, to two common springs with the compensation lever.

This construction also adds materially to the steadiness of the engine. In English locomotives, each wheel having a separate spring, that part of the shock or jerk, which is not taken up by the spring, is imparted to the frame; by the use of the compensation lever, the two springs are affected at the same time, and to the frame is imparted only a very small part of the force, which it receives entire where no such contrivance is used. The same object, of dividing the shock upon two wheels, and thus producing a smaller effect on the body of the engine, is obtained by the use of the truck-frame. The whole engine is balanced upon two centres, in such a way that, however the wheels may stand, it is but little affected by the irregularity of their position, and, as near as it is possible, always retains an exact horizontal or level position.

In fig. 1, a stay will be noticed from the back of the fire-box to the frame; another is placed—as seen in the drawing of the "Mohawk"—from the smoke-box to the frame. These stays are used in most American engines, and serve to strengthen, stiffen, and, as it were, truss the whole structure. They not only steady the smoke-box, but tend to throw what little overhang weight there is more effectually on the wheels. Another advantage of the American frame, is the saving of expense in material and labor of construction. These are the great principles by which American engineers have successfully attempted to give steadiness, stability, and durability to their engines.

I have dwelt long upon the construction of the frame, but I hope not longer than the subject deserves; the above three qualities of a locomotive, or the three virtues, are solely dependent upon a sound, well-constructed frame. A building may be ever so well and strongly built, if its foundation is bad it will fall. The same holds good in all structures, and why not in a locomotive?

New York, November, 1849.

(To be Continued.)

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*Revenue of British Railways.**

The revenue of British railways, observes a contemporary, cannot now be put down at less than twelve millions a year—a greater sum than many important political States possess. Two hundred millions of money were expended upon them up to the close of last year, and even in the midst of the deep depression of 1848, when commerce was, as it were, in a state of complete collapse, not less than £33,234,818 were expended in railway works. The number of passengers on these "new highways" during the last six months of 1848 was no less than 31,630,292, expending a sum of £3,283,301; or at the rate of 63,260,584, expending £6,566,602 for the year. In the same half-year, goods, cattle, and parcels were conveyed at the charge of £2,461,662, or £4,923,324 in the year. The amount of

* From the London Builder, No. 347.

traffic for the week before last (Sept. 22) on 4941 miles of railway was £245,550, being an increase of £19,815 over the corresponding week of last year, when the mileage was 4091. The average earnings per mile were £50, while last year they were £55.

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*Breaking of Railway Bridges.**

In August, 1847, a Royal Commission was appointed "for the purpose of inquiring into the condition to be observed by engineers in the application of iron in structures exposed to violent concussions and vibration." Among other branches of inquiry, the members of the Commission have lately been making experiments on the motion of a carriage, variously loaded in different experiments, which passed with different velocities over a slight iron bridge; the object of the experiments being to examine the effect of the velocity of a train in increasing or decreasing the tendency of a bridge, over which the train is passing, to break under its weight. The remarkable result was obtained, that the deflexion is, in some cases, much greater than the central statical deflexion, and that the greatest deflexion takes place after the body has passed the centre of the bridge.

Dividends on Railway Stocks.†

The dividends declared on ten of the principal lines of railway in England and Scotland, for the first half-year of 1849, have been as follows:

1	at	£7		per cent.	per annum.
3	at	4		"	"
1	at	3	5*s.*	"	"
2	at	3		"	"
1	at	2	18*s.*	"	"
1	at	2	2*s.*	"	"
1	at	1		"	"

Two others have earned $1\frac{1}{8}$ and $3\frac{1}{2}$ per cent. per annum, but as yet no dividend has been declared upon them.

India Rubber Buffers and Springs.‡

India rubber buffers and springs have now been introduced, it is said, on upwards of fifty lines of railway, and stood the test of heat and cold, and wear and tear, so as to form a cheap and useful substitute for the old apparatus. Needing no cumbrous extension beneath the wagon or carriage framing, they can be fitted to newly-built wagons, it is alleged, for about £4 10*s.* a set, and the wear and tear of the old buffers, estimated on luggage trains at 50 to 60 per cent. on their own much greater cost, thus reduced to 10 per cent. The material has also been tried for bearing springs, but has not hitherto come into use as such.

* From the London, Edinburgh, and Dublin Philosophical Magazine, for September, 1849.
† From the London Railway Magazine, No. 538.
‡ From the London Builder, No. 347.

AMERICAN PATENTS.

To our Subscribers.

[When the Franklin Institute first began to publish the claims of the Patents, they resolved to keep their record six months behind the current date, in order not to interfere with the right of the inventors to take out a Patent in other countries. At present, however, since the record of Patents is published in other periodicals up to their date, this precaution has become useless; and the Committee of Publication have determined to bring up their record of Patents also to the date of issue. In doing this, owing to the great number of Patents issued since the appointment of additional examiners, it has been found necessary to insert the Patent List in smaller type than has been heretofore used. Great pains have, however, been taken in its selection, and it is hoped that, while our subscribers gain in quantity of reading matter, and in the greater novelty of the List, they will lose nothing on the part of distinctness of type and legibility.—Ed.]

List of American Patents which issued in July, 1849, with Exemplifications by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

Continued from page 120.

34. For an *Improvement in Pump Valves and their Arrangement;* Thos. Thatcher, Wilkesbarre, Luzerne county, Pennsylvania, July 17.

The patentee says,—"The nature of my invention consists, 1st, in connecting together the valves of the cylinders of two alternating single acting pumps, or the valves of the upper and lower portions of the cylinder of a double acting pump, in such manner that the two injection valves cannot both be open to their full extent at the same moment; the two discharge valves being connected in like manner.

"2d, In giving the wings of valves a spiral or screw form, whereby the motion of the water through the valve causes it to rotate on its axis."

Claim.—"What I claim as my invention, is connecting the valves, substantially in the manner and for the purpose herein set forth.

"I also claim making the wings of valves of a spiral or screw form, substantially in the manner and for the purpose herein set forth."

35. For an *Improvement in Winnowing Machines;* Abraham Straub, Milton, Northumberland county, Pennsylvania, July 17.

The patentee says,—"My invention consists in the combination of a wind chest and register, by which the grain to be cleansed is exposed to a uniform current of air, the amount of which may be regulated at pleasure."

Claim.—"What I claim as my invention, is the combination of a wind chest and adjustable register with a separating box, substantially in the manner and for the purpose herein set forth."

36. For an *Improvement in Smut Machines;* Albert Buel and Thomas Brown, Lowville, Lewis county, New York, July 17.

Claim.—"What we claim as our invention, is, 1st, the combination of the beaters, ribs, and teeth, with the circular disk, constructed, arranged, and operating in the manner and for the purpose set forth.

"We also claim the combination of the perforated or reticulated curbs, let into and surrounding the central air holes of the top and bottom of the stationary cylinder, in combination with said stationary cylinder, made in the manner described; said reticulated curbs operating in the manner set forth, by which free currents of air are produced through the central openings of the top and bottom of the cylinder to the centre thereof, and thence radially from the cylinder through its sides, carrying off the smut immediately on its being separated from the grain, and before the smut can have time to descend and again become mixed with it as described."

37. For an *Improvement in Vegetable Cutters;* Wyllys Avery, Salisbury, Herkimer county, New York, July 17.

The patentee says,—"My improvement consists in causing the hopper in which the vegetables are put to revolve around the knives, which are stationary, and furnishing said hopper with inclined curved partitions or arms, which serve to hold the vegetables in contact with the knives while cutting."

Claim.—"What I claim as new, is constructing the hopper in the manner set forth, by means of the combination of inclined arms and spreading sides, in the manner and for the purpose set forth, and combining it with, and revolving it over, a series of stationary knives, as set forth."

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38. For an *Improved Deflector for Spark Arresters;* Samuel Swett, City of New York, July 24.

The patentee says,—"The principal improvement that I have made, is placing a hollow trumpet-shaped button and curved or inverted conical cap directly over the centre of the smoke pipe, and under the central opening in the dome, forming a steam way, for the purpose of receiving a portion of the escape steam, and causing it to issue in a circular stream at the periphery of the largest end of the said trumpet-shaped hollow button, by a curved cap plate placed over the large end of the trumpet-shaped button; the steam being made to issue downward in a circular sheet, and to pass obliquely through the column of smoke and sparks as it passes over the edges of the trumpet-shaped button and cap; the steam striking the sparks and driving them against the concave surface of the dome, and extinguishing the sparks and turning them downward into the space between the smoke pipe and surrounding jacket, whilst a portion of the smoke will pass with the draft through the eye of the dome, and a portion will pass through the meshes of the wire gauze."

Claim.—"What I claim as my invention, is the combination of the stationary hollow trumpet-shaped pendent button and stationary curved cap with the dome, constructed, arranged, and operating in the manner and for the purpose set forth; by which I am enabled to prevent the escape of the sparks with the smoke; the effect of the steam from the exhaust pipes entering the hollow button being three-fold: first, to force the sparks downward by coming in contact with them at the circular passage; secondly, to extinguish them, and thirdly, to increase their specific gravity, and thus cause them to fall immediately to the bottom of the cinder box."

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39. For an *Improved Whiffle-Tree Hook;* A. N. Gray, Cleveland, Cuyahoga county, Ohio, July 24.

The patentee says,—"The object of this improvement is to prevent the danger of the escape of the cock-eye, or tug, from the hooked ends of the whiffle-tree."

Claim.—"What I claim as my invention, is the manner set forth of combining the hook with the ferule, so as to admit the former to turn round in the latter, when the cock-eye, or tug, is to be inserted or removed; the respective stops, and the auxiliary hook, being arranged substantially in the manner set forth, so as to prevent the accidental escape of the tug from the hook."

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40. For an *Improvement in Calculating Machines;* Samuel S. Young, Eaton, Preble county, Ohio, July 24.

Claim.—"What I claim as my invention, is the combination of the slides with the indices and the bars, in the manner and for the purposes set forth."

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41. For an *Improvement in Making Elevator Tubes for Lamp Wicks;* Cornelius & Co., assignees of Robt. Cornelius and Chas. Wilhelm, Philadelphia, Pennsylvania, July 24.

The patentees say,—"Our invention has for its primary object the formation of tubes requiring different thicknesses of metal in different parts of the tube, or to have a spiral groove traversing either the interior or the exterior of the tube."

Claim.—"What we claim as our invention, is the manner of making the elevators of tubular lamp wicks, by combining a spiral, produced by coiling a band or ribbon of metal into a cylindrical figure, with another band of metal formed into a similar spiral, but so as to leave a spiral slot or opening between its contiguous edges, the one spiral being placed within the other, and the two breaking joints with each other, and united to form a tube, spirally grooved or screw-shaped either within or without, or both within and without at the same time, in the manner and for the purposes set forth."

42. For an *Improvement in Casting Types;* John Batchelder, Boston, joint inventor with, and assignee of, Simon D. Dyer, Chelsea, Suffolk county, Massachusetts, July 24.

Claim.—"What we claim as our invention, is a combination of machinery made up of the following elements, or their mechanical equivalents, the same consisting of the endless chain and its wheels, the series of mould sections applied thereto, and having moulds made in them, essentially as described; one or more plates or walls, (having one or more air escape holes made through them,) and the vessel *u*, or other suitable substitute; all made to operate together substantially in the manner and for the purpose specified."

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43. For an *Improvement in Seed Planters;* R. H. Springstead, Wooster, Wayne county, Ohio, July 24.

Claim.—"What I claim as my invention, is the making use of open inclined conductors, for conveying the grain or seeds from the grain box to the ground, when combined with the series of gates, and the movable adjustable side of the grain box, for regulating and governing the discharge of the seeds or grain therefrom, substantially as described.

"I also claim the manner of arranging and combining the series of reciprocating and vibrating stirrers with each other within the grain box, substantially in the manner and for the purpose set forth.

"I also claim the combination of the reciprocating and vibrating stirrers with the continuous discharging aperture in the grain box, and the regulating gates connected therewith, and with the series of inclined open seed or grain conductors, substantially in the manner set forth."

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44. For an *Improvement in Hill-Side Ploughs;* Allen Eldred, Little Falls, Herkimer county, New York, July 24.

Claim.—"What I claim as new, is constructing a hill-side plough substantially in the manner described, by making the entire land-side stationary, and combining therewith two mould-boards revolving on a shaft above said land-side, so as to turn a furrow on either side when brought into position by means of a crank, or other analogous device, near the handles of the ploughs."

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45. For an *Improvement in Sofa Bedsteads;* Edwin B. Bowditch, New Haven, Connecticut, July 24.

Claim.—"What I claim as my invention, is the construction of a seat or bed, placed under the ordinary seat of a sofa, couch, lounge, or any other suitable piece of furniture, which will revolve on suitable pins or pivots of wood or metal, at each end, working in slots, as described; said seat or bed to be hinged to the ordinary seat in such a manner that, when the ordinary seat is drawn or lifted forward, the under seat or bed will revolve, and come on a level with the ordinary seat, which, combined, will form a level and good sized bed."

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46. For an *Improvement in Connecting Hubs with Axles;* Junius Foster, Bridgeport, Fairfield county, Connecticut, July 24.

The patentee says,—"The nature of my invention consists in fastening the hubs of carriage wheels on to their axles, by means of a spring catch which fits in a groove made in the inner end of the hub, the said catch being on the end of a spring attached to the top of the axle, and provided with a pin which passes through a hole in the axle, and extending to a sufficient distance below it to admit of forcing up the catch out of the groove in the hub, for the purpose of taking off the wheel."

Claim.—"What I claim as my invention, is securing the hub of a carriage wheel to its axle by means of a catch or segment collar, fitting in a groove of the hub or pipe-box, in combination with the spring connexion of the said segment collar, and the pin or other projection passing down below the axle, substantially as described, to admit of disconnecting the collar in lifting up the wheel, as described."

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47. For an *Improvement in Apparatus for Unloading Carts, &c.;* Charles Downer, Philadelphia, Pennsylvania, July 24.

Claim.—"What I claim as my invention, is the combination of the upper or tilting frame with the lower frame, the latter being either stationary or on wheels. I furthermore claim the central lever, with its check and hook, in combination with the stanchion rod, the cam,

and the stanchions; and said lever, check and hook, stanchion rod, cam, and stanchions, in combination with the tilting frame, being mounted either on a stationary frame or on wheels; the construction, arrangement, and operation of all of which being substantially in the manner and for the purposes described."

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48. For an *Improvement in Metallic Boot Heels;* G. S. Langdon, Rising Sun, Maryland, assignee of Patrick S. Devlan, Reading, Berks county, Pennsylvania, July 24.

The patentee says,—"My invention and improvement consists in making a hollow metallic heel for boots and shoes in two parts, one placed within the other, with a spring between them, to support the weight of the body, and prevent the unpleasant shocks produced by the concussion of the ordinary boot heel upon a hard surface when the wearer is walking fast."

Claim.—"What I claim as my invention, is making a metallic tread for the heels of shoes and boots, separate from, but secured within, the casing of the heel, in such a manner that it shall be free to change its position, to accommodate itself to the inequalities of the surface of the ground, whereby it wears more evenly, and is less fatiguing to the foot than a rigid heel, in the manner set forth."

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49. For an *Improvement in Ploughs;* John Rich, Troy, New York, July 31.

The patentee says,—"My improvement consists in the mode of constructing the bed or nose-piece of a plough, for the securing of the mould-board thereto, and of the manner of securing the handles."

Claim.—"What I claim as my invention, is, 1st, the manner of forming the bed of a plough, with a socket for the admission of the handles, and securing the mould-board to the bed by means of the knob; the one wedge serving the double purpose of retaining the mould-board and lower ends of the handles in place, in the manner described.

"2d, I also claim the so constructing the brace as to make a firm rest and fastening for the handles, thereby rendering an effective and simple fastening for the handles of a plough; the whole being arranged substantially as set forth."

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50. For *Improvements in Movable Breeches for Fire Arms, and the Locks and Appurtenances of the same;* Benjamin Chambers, City of Washington, D. C., July 31.

The patentee says,—"My improvements have reference as well to the construction as to the mode of using cannon, the object being to produce such an improvement in fire arms as will secure all the strength necessary, together with suitable weight of metal, and a prompt, safe, and easy mode of charging and discharging the piece."

Claim.—"What I claim as new, is forming the breech of a gun, and its breech-piece or pin, with sectional screws cut therein, for the purpose of speedily opening the breech for swabbing, depositing the load, and readily closing it again when the gun is to be discharged, as set forth.

"2d, I also claim, in combination with a sectional screw breech-piece, the hinged support, the slot, and lever, whereby the said breech-piece is easily moved into and out of place in closing and opening the gun, for the purposes set forth.

"3d, I also claim forming the gun-lock in such a manner that the hammer-rod, and percussion rod shall be in separate pieces, laying axially within the same barrel, whereby the coiled main spring is made to urge the hammer-rod against the head of the percussion-rod to discharge the piece, and the recoil spring on the percussion-rod is made immediately to draw back, and hold the valve which closes the interior of the lock against access of smoke and gases, as set forth.

"4th, I also claim, in combination with a gun having a dissected screw breech, the flanched shield through which the cartridge is made to pass into the chamber over the dissected screw, without danger of being broken by the ends and edges of the threads, as set forth.

"5th, I also claim the perforated point or nipple on the percussion cap, for penetrating the enclosing material of the cartridge, and insuring the discharge of the gunpowder when the percussion is given in the rear of the cartridge, in the manner herein set forth.

"6th, I also claim, in combination with a rammer for charging guns at the breech, the projecting central point, whereby the cartridge, in being driven to its place in the chamber, is perforated at its base to receive the point of the percussion cap herein described, for the purpose of insuring the ignition of the gunpowder, as set forth.

"7th, I also claim the enlargement near the shoulder of the rammer, whereby the shield, through which the cartridge has been rammed, is made to adhere by friction to the rammer, and to be drawn out of the breech of the gun without requiring a separate operation for taking it out."

51. For an *Improvement in Machines for Pegging Boots and Shoes;* James La Dow, Granville, Licking county, Ohio, July 31.

Claim.—"What I claim as my invention, is the manner described of simultaneously punching one or more holes in the leather, and driving pegs into others previously made, by means of the awls and punches, arranged as described, or in any substantially similar manner.

"2d, The manner of supplying the pegs to be driven by the punches, by conveying them from the hopper in a channel which turns them from a horizontal to a vertical position, with the points downwards, ready to be driven into the holes punctured in the leather for their reception.

"3d, The combination of the guide-point with the set-screw, for regulating the distance of the pegs from each other, and from the edge of the sole.

"4th, The manner of raising the holder by means of a thumb lever, whether aranged and operating as described, or in any other substantially similar manner.

"5th, The combination of the bent lever, connecting rod, and pushers, for the purpose of driving the pegs out of the hopper into the channels which convey them to the punch holes."

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52. For an *Improvement in Equalizing the Action of Gearing in Horse Powers;* Charles Caples, Savannah, Andrew county, Missouri, July 31.

The patentee says,—"My invention consists in attaching the wheels to their spindles by flexible bars or springs, instead of the usual rigid methods of keys, plugs, or pins."

Claim.—"What I claim as my invention, is equalizing the strain, and lessening the force of shocks upon a train of cog-wheels, by connecting the wheels with their shafts by springs, substantially as set forth."

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53. For an *Improvement in the Process of Hardening Metals;* Asa Wheeler, Warwick, Franklin county, Massachusetts, July 31.

Claim.—"What I claim, is hardening steel or iron by immersing it below the surface of, and in, water, and then causing one or more jets to play through the body of the water, and against the metal or part thereof to be hardened."

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54. For an *Improvement in the Valves of Rotary Engines;* Jas. P. Ross, Lewisburg, Union county, Pennsylvania, July 31.

The patentee says,—"The nature of my invention consists in the mode of connecting the runner or piston with the annular chamber, the construction, adaptation, and mode of operation of the valve, and the connexion therewith of the cut-off when used."

Claim.—"What I claim as new, is the sliding valve, constructed as described, with an exhaust port therein, which is stopped by the piston while it is opening the valve, as set forth."

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55. For an *Improvement in Signal Lanterns;* George Callard, Buffalo, New York, July 31.

The patentee says,—"My invention consists of a revolving cylinder, having a particular arrangement of colored and plain glass, by various combinations of which the different signals are made, and all positions in which a sailing vessel may be placed are indicated."

Claim.—"What I claim as my invention, is the revolving cylinder of colored and plain glass, arranged in a portable signal lantern, in the manner and for the purpose herein set forth."

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56. For an *Improvement in Machines to Beat and Brush Carpets;* William Peters, Charlestown, Middlesex county, Massachusetts, July 31.

Claim.—"What I desire to claim as my invention, is the employment of dusters or beaters, as herein described, for dusting or cleansing carpets or other fabrics of the same sort, not wishing to limit myself to the exact method of employing the power."

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57. For an *Improvement in Paring, Coring, and Slicing Apples;* Julius Weed, Painesville, Lake county, Ohio, July 31.

Claim.—"What I claim as my invention are the following particulars: 1st, The arrangement of a segment wheel attached to a shaft, said shaft having a socket with projecting arms, for the insertion of the knife handle; said segment wheel meshing into a bevel wheel formed on the driving wheel, which said bevel contains a bare space and wide cog, for the purposes

described; the said shaft having a swinging or vibrating weight attached thereto for the use above stated.

"2d, The arrangement of a sliding corer, for coring the apple, and for detaching it from the fork, and the guide for dropping the apple from the coring tube, as described.

"3d, A slicing apparatus, with cutters or slicers of tin or steel, of the form and arrangement as described, placed under the foundation, and connected with the driving wheel aforesaid, so as to perform the operation of slicing, at the same time with that of paring.

"4th, The arrangement of paring, coring, and slicing, combined in the same machine, as described. And I make no other claim."

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58. For an *Improvement in Ploughs;* Jesse Warren, Glen's Falls, Warren county, New York, July 31.

The patentee says,—"The character of my invention and improvements in the plough consist in the construction and combination of the combined cutter and bed-point with the mould-board.

"Also, in constructing the mould-board in two pieces or sections, the upper half of which being movable and made adjustive by means of a hook-bar, to give more or less turn to the sward in ploughing; and also adapting the mould-board for various kinds of soil. And in combining with the plough, next its land-side, a sustaining and gauging wheel, for gauging the depth of the furrow and relieving the plough.

"Likewise in placing a horizontal adjustive leveller and weed cutter in front of the sustaining wheel, fixed to a shield projecting up in front and over the wheel, to protect it from accident. Also, the manner of attaching and securing the rear end of the mould-board permanently to the inside of the landside of the plough, by means of a trapezoidal-shaped connecting plate bolted to the land-side. And likewise the manner of securing the land bar to the land-side of the plough."

Claim.—"What I claim as my invention, is, 1st, the exclusive use of a mould-board composed of two sections or parts, the lower section or part being secured to the land-side by the trapezoidal-shaped plate, and extension or bed upon which it rests, the upper section or part being adjustive and joined thereto by projecting pivots upon which it turns, and adjusted and secured by means of a hook-bar fixed to the land-side; the whole being constructed and arranged in the manner described.

"I also claim the manner of securing and attaching the land-bar to the land-side, as described.

"I likewise claim the combination of the adjustive weed cutter and leveller with the land-side and adjustive sustaining wheel, as described."

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59. For an *Improvement in Apparatus for Filtering Water, &c.;* Justin Mulhern, St. Louis, Missouri, July 31.

Claim.—"What I claim as my invention in my improved apparatus for purifying Mississippi river water, is the combination of the settling chambers and filtering compartments, substantially in the manner set forth, to wit: The first settling chamber, being the reservoir or head, extending under the first filtering compartment, and the remaining settling chambers being nearly in the form of an L, with the vertical portion of each chamber, for the passage of water, situated between two filtering compartments, and sufficiently large to admit of easy access for cleansing, and its horizontal portion extending under one of the said filtering compartments: by which arrangement the water will filtrate upwardly from the reservoir, through the first filtering compartment, and flow thence into the vertical portion of the next settling chamber, in which it will descend into the horizontal portion of the same, and thence will ascend through the second filtering compartment, and thus continue its course through the entire series of settling chambers and filtering compartments till it reaches the pure water reservoir at the opposite end of the apparatus; by which combination and arrangement free access can be had to the settling chambers and filtering compartments, for the purpose of cleansing them, substantially as herein set forth. Not intending, by the above claim, to cover the general principle of the combination of a series of settling chambers with upwardly filtering compartments; the gist of my invention consisting in such an arrangement and combination of settling chambers and filtering compartments as will give free access to both of them, for the purpose of cleansing them of foul deposits, substantially as herein set forth."

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60. For an *Improvement in Bee Hives;* Joseph A. Dugdale, Selma, Clark county, Ohio, July 31.

Claim.—"What I claim, 1st, is a sash door with a woven wire screen, in combination with

projecting parts of the hive, so constructed as to form a recess or space in front of the hive, of sufficient size to accommodate a cluster of bees according to their habits of hanging outside the hive; and so that they may be enclosed and protected whether outside or inside of the hive, by closing the door at night, from the moths, as specified."

RE-ISSUE FOR JULY, 1849.

1. For an *Improvement in the Machine for Cleaning Wool from Burs and other foreign matter, and also for Ginning Cotton;* Milton D. Whipple, Lowell, Middlesex county, Massachusetts; patented October 28, 1840, re-issued July 31.

Claim.—"I claim, 1st, the machine as a whole, consisting in general of the constituent parts in combination, as described, and that, though equivalents may be substituted for some of these parts, for like purposes and substantially the same, viz., the combination of the common feeding and picking apparatus with the comb-toothed cylinder.

"2d, I claim forming and arranging the teeth of cylinders for burring wool and cleaning cotton, and other fibrous substances, in such a manner that their outer convex sides shall be substantially concentric with the axis of the cylinder, for the purpose of seizing and holding the fibres, and presenting a surface against which the guard can act in removing burs and other foreign matter therefrom."

DESIGNS FOR JULY, 1849.

1. For a *Design for Stoves;* North, Harrison & Co., Philadelphia, Pennsylvania, assignees of Samuel W. Gibbs, Albany, New York, July 10.

2. For a *Design for Cooking Stoves;* A. C. Barstow, Providence, Rhode Island, July 10.

3. For a *Design for Stoves;* Samuel Hill and Stephen B. Cline, Philadelphia, Pennsylvania, July 17.

The claim to each of the above patents is for the designs as represented in the specifications.

List of American Patents which issued in August, 1849, *with Exemplifications by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improvement in Salting Meats;* Thomas Davison, City of New York, August 7.

The patentee says,—"The nature of my invention consists in communicating motion to meat while undergoing the process of salting or curing, causing the brine, or other substance with which it is desired to impregnate it, to circulate around all the pieces of meat, in order to supply the surface as rapidly as it is absorbed by the interior portions; and also, by keeping the particles of the meat in motion, effecting a rapid transfer of the salt from the particles on the outside to those adjoining, and so on till the whole piece is salted."

Claim.—"What I claim as new, is rotating or otherwise moving, as described, the flesh of animals, while in contact with salt or other substances with which it is desired to impregnate it, thereby accelerating or aiding their incorporation or mixing more readily than can be done by hand."

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2. For an *Improvement in Gas Lamps;* Horatio G. Sickel, Philadelphia, Pennsylvania, August 7.

Claim.—"What I claim as my invention and improvement in lamps for producing light, by burning the vapor or gas generated within itself, in the manner of gas burners, is, 1st, the mode of regulating and extinguishing the light, when required, by means of a valve formed by the top of the inner cylinder, and the end or surface of the button attached to the head of the outer cylinder, whether the several parts forming said valve be made and arranged in the manner described, or other mode substantially the same, by which similar results shall be produced.

"2d, I also claim the employment of the safety valve, in combination with the guard-plate, constructed substantially as described.

"3d, I likewise claim the use of the guard, in combination with the combined burner and generator, arranged and operating in the manner and for the purpose set forth.

"4th, I also claim combining the generator, burner, ring, and guard, in a single piece, made to ascend and descend simultaneously in the manner and for the purpose substantially as set forth."

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3. For an *Improvement in Argand Burners for Gas Lamps;* John G. Webb, Williamsburg, Kings county, New York, August 7.

Claim.—"I claim the application of the conductor and button, acting in the centre of an Argand burner, to conduct heat to the liquid matter in the wick below, for the purpose of making the Argand burner a self-generator of the gas it consumes; substantially in the manner and with the effects described."

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4. For an *Improvement in Gas Apparatus;* Andrew Walker, Jr., Burke, Caledonia county, Vermont, August 7.

Claim.—"What I claim as my invention, is the mode of washing the gas, or evaporating the acid, the same consisting in the employment of a close horizontal vessel, and a current of water made to flow through it as specified, and passing the gas into one end of the vessel and water, and out at the other end thereof, all essentially as specified.

"I also claim the combination of a lime cistern or vessel with either the gas holder or purifier, in manner and for the purpose as above specified; not meaning to claim the use of lime for abstracting moisture, as the same is a well known absorbent."

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5. For an *Improvement in Blocks for Setting Hat Brims;* Sylvester Billings, Spring Garden, Philadelphia county, Pennsylvania, August 7.

The patentee says,—"The nature of my invention consists in providing a heater for softening the brim of a hat, in order that it may receive the proper curl and shape."

Claim.—"What I claim as my invention, is the combination of the convex surface and the iron or metallic weight, made concave to fit the convexity of the convex surface, as represented."

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6. For an *Improvement in Securing Hooks and Eyes to Tape and Dresses;* Charles Atwood, Derby, New Haven county, Connecticut, August 7.

The patentee says,—"The nature of my invention consists in bending and forming the shanks of hooks and eyes made of wire, and the attaching them to the tape by their shanks, in the manner described."

Claim.—"What I claim as my invention, is the oblong loop or eyelet, in combination with the hook and eye, so as to fasten them to garments by means of tape, and by me designated 'Tape Hook,' as described; and also the attaching of hooks and eyes to tape, as described, so as to form the article by me designated 'Hook Tape.'"

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7. For an *Improvement in Pessaries;* Jonathan H. Robinson, Charlestown, Middlesex county, Massachusetts, August 7.

Claim.—"What I claim as my invention, is forming a stem pessary, with a shield to fit around the labia, and to which the supporting straps may be connected, substantially in the manner and for the purpose specified."

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8. For an *Improvement in Bedstead Fastenings;* Henry Miller, South Bend, St. Joseph county, Indiana, August 7.

Claim.—"What I claim as my invention, is the combination of the cord and slat bottom, and use of pulleys, and the methods of suspending it; and also the method of straining the cord by the ratchet windlass."

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9. For an *Improvement in Cleansing Bottles;* Munson C. Crouk, Auburn, Cayuga county, New York, August 7.

The patentee says,—"The nature of my invention consists in applying the principle of hydrostatic pressure to the use and purpose of cleansing mineral water and beer bottles."

Claim.—"What I claim as my invention, is the application of the apparatus, substantially as set forth, for the purpose of cleansing bottles."

10. For an *Arrangement of Weight and Pulley for Closing Gates;* Willard Twitchell, Syracuse, Onondaga county, New York, August 7.

The patentee says,—"The nature of my invention consists in so attaching a pulley to the post of the gate, that its position will change with the change in the direction of the cord, as the gate is opened or closed, thereby enabling me to get the full effect of the weight with a single pulley."

Claim.—"What I claim as my invention, is the application of a swivel pulley for closing a gate, when the cord to which the weight is attached is fastened to the gate below the level of the said pulley, whereby it acts not only as a gate closer, but also as a support to prevent the gate from sagging; the whole constructed substantially as described."

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11. For an *Improved Method of Regulating the Contraction of Car Wheels;* John Murphy, Kensington, Philadelphia, Pennsylvania, August 7.

Claim.—"What I claim as my invention and discovery, is the mode of cooling, and thereby regulating the contraction of chilled railroad car and other wheels and pulleys with solid hubs, by the application of a stream of cold air to the hub in the manner described, in combination with the non conducting case for retarding the cooling of the rim, as set forth."

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12. For a *Machine for Making Spiral Springs of Wire;* William Van Anden, Trenton, New Jersey, August 7.

Claim.—"What I claim as my invention, is the entire method herein described of making springs of curved character, in flat or spiral form, in the manner set forth, namely, by forcing the wire, by notched toothed wheels or otherwise, between friction rollers, tubes, or smooth bars, so as to form a wire spring into a curved and spiral form at the same time, by means of varying the tool as described. Also, the method set forth of varying the size of the curve, by moving the operating tool by a cam, inclined plane, or any similar mechanical contrivance."

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13. For an *Improvement in the Manufacture of Button Moulds;* Josiah Hayden, Williamsburg, and Rufus Hyde, Chesterfield, Hampshire county, Massachusetts, August 7.

The patentees say,—"Our improvement consists in so constructing the machine that, by inserting a strip between the upright plate and the friction roller which is attached to it horizontally parallel to its face, and setting the machine in motion, the whole strip will be worked into button moulds without any further attention to the machine.

"And in having two bits, in separate arbors, one to cut each side of the mould, but cutting at different times, alternately; the arbors of which bits receive a gradual vibratory motion toward and from the strip, by means of levers, one end of each of which levers works against the cam on one or other of the cam wheels, so that one is drawn back while the other is cutting. And by a ratch wheel, which is worked by a rack attached to one end of a lever, which causes the feeding motion at the proper time, so that the machine may be constantly fed."

Claim.—"What we claim as our invention. is the use of the ratch wheels, rack, and lever, one or more friction rollers, rack, and lever, to produce the feeding motion, when combined with the method of holding the strip, and the alternate vibratory motion of the bits, produced by the operation of the cams, thus constituting a self-acting and self-regulating machine, when the whole is constructed, arranged, and combined substantially as herein described."

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14. For an *Eccentric Piano Lock;* Peter H. Niles, Boston, Massachusetts, August 7.

The patentee says,—"The distinguishing feature of my new lock is, that the bolt, which moves laterally, and is cut out in the ordinary way, so as to engage with a vertical hasp on the lid of the piano case or trunk, is operated by an eccentric, which fits into a proper hole in a metallic plate appended to, or cast on, the under side of the bolt, said eccentric being moved directly by the key."

Claim.—"What I claim as my invention, is a piano case or trunk lock, in which the bolt is thrown out and in by an eccentric, substantially as herein above described."

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15. For *Improvements in Locomotive Spark Arresters and Smoke Conductors;* Josiah F. Flagg, Boston, Massachusetts, August 7.

Claim.—"I claim, in combination with the deflector for directing downwards the current of sparks in a locomotive chimney, the inverted conical jacket or cullender, when perforated with horizontal holes, and each hole furnished with flanches which project upward within,

and downward on the outside of, said jacket, whereby the sparks are directed down into the space between the jacket and the outer case of the chimney, and are prevented from raising upward, as set forth.

"I also claim, in combination with a horizontal chimney for locomotives, the mouth-piece or inhaler, having two upright partitions meeting in an edge or vertical line at the front, whereby the two parts of a divided current of air are made to pass around the sides of the interior chimney, and to unite beyond the opening which gives exit to the smoke or gases, in such manner as to augment the draft of the horizontal flue while avoiding the entrance of the air to the vertical part of the chimney.

"I also claim, in combination with a horizontal flue for locomotives, the movable inhaling valves, which form the lateral gorges for the purpose of creating draft within the horizontal flues, in the manner and for the purposes set forth, whereby the amount of draft may be increased or diminished at pleasure, whether the cars move with one or the other end foremost."

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16. For an *Improvement in Cooking Stoves;* Nicholas Mason, Roxbury, Norfolk county, Massachusetts, August 7.

The patentee says,—"The nature of my invention consists in causing the heat and smoke from the fire chamber to pass over the oven, and down diving flues on the ends and back of the oven, and under the same towards the front part of the stove, when they descend and enter another flue immediately below, which conducts them to a vertical flue at the back part of the stove, leading to the smoke pipe, thus causing the oven to be entirely surrounded with heat when desired, to cook the meats in the oven alike on all sides."

Claim.—"1st, What I claim as my invention, is the mode of forming diving flues at the ends of the oven, and opening and closing the communication through the same by means of the doors arranged inside the oven, and connected to the outer doors by links or hinged plates, and the swinging dampers operated by said inner doors, in the manner and for the purpose herein set forth; and, in combination with said flues, I claim the upper and lower horizontal flues and back diving flue, for conveying the heat around the oven and back into the smoke pipe, as indicated by arrows in the figure, and herein described.

"2d, I also claim the combination of the door on the side of the stove, with the box or drawer inserted in a corresponding formed case at the bottom of the stove, for the double purpose of forming a return flue for the smoke and heat, and a receptacle for soot, &c., cleaned from the flues, as described."

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17. For an *Improvement in Forming and Balancing Mill Stones;* Edmund Munson, Utica, Oneida county, New York, August 7.

The patentee says,—"The nature of my invention consists in the construction of a machine or apparatus on which the mill stone, after it is blocked up, is suspended upon its centre, and in balancing it there in the course of filling up and finishing, instead of filling up the same without the means of testing the accuracy of its balance, leaving that to be done by the millwright (as is usually the case) in hanging the stone for actual use in the mill."

Claim.—"What I claim as my invention, is the mode herein described of testing and balancing mill stones, by being enabled, by the means here described, to observe the balance of the stone, while the same is in motion as well as at rest, and at the same time to correct the inaccuracies of its balance during the progress of construction.

"I also claim the use of the machine here described for turning off the exterior of the mill stone in finishing the same, as herein mentioned, in combination with the use of the same machine in testing the balance of the stone, as above set forth; the whole being arranged and combined substantially as herein set forth and described."

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18. For a *Reversible Life Boat;* George P. Tewksbury, Boston, Massachusetts, August 7.

Claim.—"What I claim as my invention, is the buoyant boat constructed with the opening, and the movable platform or floor placed within the same, and made to operate therein, substantially in the manner and for the purpose as specified. And, as auxiliary thereto, I claim the combination of one or more thwart frames, as constructed, applied to the same, and made to operate in connexion with the platform, essentially as described."

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19. For an *Improvement in Self-Acting Cheese Presses;* Ira Carter, Plattsburg, Clinton county, New York, August 14.

The patentee says,—"The nature and principle of my invention consists in providing a

movable elevating cheese table, and combining it with a cross-head lever having racks at the ends of its arms, and, by the peculiar combination of pinions and wheels, I am enabled to suspend the whole weight of the cheese table on the ends of the levers, and gradually decrease the space between the cross-head of the lever and cheese table, so as to press cheese curd or cheese that may be placed on the cheese table, by the lever bearing downwards on the same, by the weight of the cheese table and its appendages, suspended on the ends of the lever."

Claim.—"I claim the cross-head lever, constructed with the racks as described, in combination with the cheese table and the stationary racks, by means of the wheels and pinions, operated by the pinion J, in the manner represented, for the purpose of elevating the cheese table and the cross-head lever, but especially for exerting a continual self-acting pressure upon the cheese, by the space between the cross-head and the cheese table decreasing as the cheese is being compressed, substantially as described."

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20. For an *Improvement in Road Scrapers;* Benj. M. Townsend, Quincy, Adams county, Illinois, August 14.

The patentee says,—"My invention consists in a device, by which the angle formed by the share with the line of draft can be changed while the scraper is in motion, and in the peculiar manner in which the upper edge of the share is connected with the hind end of the beam, by which it is securely attached to the beam when scraping, but easily and instantly disconnected therefrom to allow the share to turn and discharge the scraped earth."

Claim.—"What I claim as my invention, is the device, consisting of brace-rods, sliding eye-bolts, connecting rod, hand lever, and spring catch, for changing the angle formed by the share with the line of draft, arranged and operated substantially as set forth."

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21. For an *Improvement in Rice Hullers;* Charles Walker, Brooklyn, Kings county, New York, August 14.

The patentee says,—"The nature of my invention consists in providing two conical rings or parts of cast iron, and these to be coated with vulcanized caoutchouc or India rubber, by which the surface of rice or other grain may be rubbed in a severe manner, so as to break and peel off the skin or hull of the grains of rice, coffee, or other grains, without pulverizing the inner part or grain itself."

Claim.—"What I claim as my invention, is covering the rubbing cylinder and concave, or other rubbing surfaces of rice, or grain hullers, with vulcanized India rubber, in the manner described."

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22. For an *Improvement in Machines for Ruling Paper;* William S. Wilder, Boston, Massachusetts, August 14.

Claim.—"What I claim as my invention, is the expansion belt and projection, in combination with the endless apron R, and the machinery for gauging and delivering the sheets of paper thereto, substantially as specified; the said machinery being the endless aprons D and G, and the gauge."

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23. For an *Improvement in Steam Tables;* Edwin Hills, Cincinnati, Ohio, August 14.

The patentee says,—"The object of my invention is a new and improved steam table, for heating crushed oil seed preparatory to subjecting the same to the action of the press, to extract the oil therefrom."

Claim.—"What I claim as my invention, is the combination of the hollow top and bottom of the tables with the hoop; the same being made and arranged substantially in the manner and for the purpose described.

"I likewise claim making the hollow top with a recess in its under side, into which to raise the stirrer while the hoop is being withdrawn, in the manner and for the purpose set forth."

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24. For a *Method of Uniting Metallic Plates to each other;* Samuel Pratt, Cohasset, Norfolk county, Massachusetts, August 14.

The patentee says,—"The nature of this invention and improvement consists in making two or more incisions in the hoop plate, near the ends of the same, or in the pieces of metal to be joined, of the form of a right angle, by means of a punch or in any convenient manner, so as to cause the body of metal between the angular incisions in one plate or piece, or on one end of the hoop plate, to be raised above the surface of the same, and the metal between the angular incisions of the other plate, or opposite end of the hoop plate, to be depressed

below its surface, in such a manner as to allow of the projecting portions near one end of the hoop plate or piece of metal to be passed through the incisions near the opposite end of the hoop plate, or in the other metal plate, to be joined and locked into the same, and the projecting portions to be pressed together."

Claim.—"What I claim as my invention, is the mode of securing together the extremities of metallic hoop bands, to form hoops or metallic plates, by making angled incisions in the same, and locking the projecting portions of metal between the lines of said incisions into each other, and pressing or hammering them together, so as to form smooth surfaces above and below, in the manner described."

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25. For an *Improvement in the Process of Flouring;* David P. Bonnell, Tecumseh, Lenawee county, Michigan, August 14.

Claim.—"What I claim as my invention and improvement, is the process of re-grinding the offal of wheat immediately after it has passed from the 'bolts,' and putting it through lower 'dusters' or 'bolts,' and returning the flour to the 'cooler,' to be re-bolted with the superfine flour; all by a continuous operation, after the manner described, so as to produce three new results: 1st, to get a greater quantity of superfine flour out of any given amount of wheat than is now obtained by any known method; 2d, by exhausting the moisture of the grain to prevent the flour from becoming sour; and 3d, to reduce the products to two kinds—superfine flour and a final residuum or bran, increasing the former and decreasing the latter or less valuable product; all as herein fully set forth."

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26. For an *Improved Arrangement of Steam Boiler and Furnace thereof;* Horace Boardman, Plattsburg, Clinton county, New York, August 14.

The patentee says,—"The nature of my invention consists in giving to the fire box or combustion chambers of boilers the form of an inverted cone or pyramid, surrounded by a water case of the same general form, the thickness of the upper part of which is greater than the lower, and communicating at its upper part, by passages through the water casing, with an inverted pyramidal chamber, by which the products of the combustion are conveyed downwards and discharged below the fire box; the outer or gas chamber is of greater area at its top, where it communicates with the interior of the fire box, than it is at its bottom, where the spent gases are discharged. The combustion of the fuel in the fire box is maintained by a blast introduced in a wind chest beneath the grate, and heated by the spent gases; the inflammable gaseous products of the combustion are burned by the introduction of jets of air at the passages through the water casing."

Claim.—"What I claim as my invention, is giving the combustion chamber of boilers an inverted conical or pyramidal form, so as to make the area of the upper horizontal section greater than that of the lower, surrounding it with a water casing, and with a gas chamber, also of increased capacity at the top, and attaching the several parts to the flat bottom of a boiler which forms the top of the combustion and gas chambers; the water casing and the flat bottomed vessel being connected with each other, and the whole forming one boiler, the several parts of which are arranged substantially in the manner and for the purposes herein set forth.

"I likewise claim the injection of a jet or jets of air at the flues or passages which connect the combustion chamber with the gas chamber, for the purpose of igniting the gases and retarding their progressive motion towards the bottom of the gas chamber."

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27. For an *Improved Arrangement of Filters for Steam Boilers;* Edmund Blunt, Brooklyn, New York, August 14.

The patentee says,—"The first part of my invention consists in using, in combination with the feed or supply pipe of steam boilers, and between the boiler and the supply pump or pumps, a series of two or more filters, so adapted and arranged that, after one filter has been used, the feed or supply water can be made to pass through another filter, and thus admit of cleaning the filters without interrupting the supply of water to the boiler.

"And the second part of my invention, which relates to the cleaning of the filters, consists in connecting the series of filters with the blow-off pipe of a steam boiler, that the water forced out of the boiler may be forced through the filters in the reversed direction, for the purpose of cleaning them out."

Claim.—What I claim as my invention, is the combination of a series of filters with the supply or feed pipe of a steam boiler, and placed at some point between the supply pump and the boiler, substantially in the manner and for the purpose specified, whether the series be made to shift to the supply pipe or *vice versâ*.

"I also claim the above combination of the series of filters and supply or feed pipe, in combination with the blow-off pipe of steam boilers, for the purpose and in the manner specified; and this I claim, whether the series of filters be made to shift to the blow-off pipe or *vice versâ*, as specified."

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28. For an *Improvement in Covered Buttons;* William R. Hitchcock & Co., Waterbury, New Haven county, Connecticut, assignees of Peter Kirkham, Birmingham, England, August 14.

Claim.—"I claim the forming of the button with its two parts, top and bottom, made of wood, joined together by appropriate fitting parts in the one to coincide with the other, to secure the textile covering inside, and the shank likewise, in the manner substantially as herein described, or in any other manner substantially the same."

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29. For an *Improvement in Meat Cutters;* Allen Burdick, near Glenn's Falls, Saratoga county, New York, August 21.

The patentee says,—"My invention consists in the combination and arrangement of the vibrating spring beam with its knife stock and knives, the latter made to rise and fall vertically, and a rotating block on which the meat is minced; and also combining with these a boiler in which steam is generated, and made to escape and come in contact with the knives, for giving them a proper temperature to prevent the meat adhering thereto, and imparting to the meat a quality which greatly facilitates the process of seasoning."

Claim.—"What I claim as my invention, is, 1st, the use of the vibrating spring lever, for the purpose and in the manner described and represented.

"2d, I claim the use of steam for heating and moistening the cutters, as described."

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30. For an *Improvement in Mills for Sawing Ship Timber, &c.;* John W. Cochran, London, England, August 21.

The patentee says,—"The first part of my invention relates to the mounting of saws in a saw gate, in such a manner as to admit of turning on their axes, and to slide laterally, for the purpose of cutting timbers in curved or diagonal lines, and consists in hanging the saws in swivels sustained on spherical friction rollers.

"The second part of my invention relates to the mode of turning saws mounted on stretchers, or otherwise adapted to swivel on the gate, and consists in connecting the swivels, or other turning apparatus to which the saws are attached, by means of feathers or ribs, on a tumbling shaft parallel with the saw, and connected with the swivels by means of arms or parallel motions, when this is combined with keys in which the feathers or ribs on the tumbling shaft slide during the motions of the saw gate, and by means of which the saw can be turned in any desired direction.

"The third part of my invention relates to the mode of determining the bevels of cuts on saw mills, in which the log or timber is so hung as to admit of sliding laterally and turning on any determined axis of motion, and consists in determining the bevel to be cut, by means of a graduated circular plate attached to the mandril that carries the log, when this is combined with a horizontal hinged bar on a horizontally sliding frame, so that when the hinged bar is set to any given angle for the determined bevel, and the graduated plate is set to the bar, the log or timber may be moved, that, as the log advances towards the saw, the given graduation on the plate may be made to follow the hinged bar, and, after a length has been cut, the sliding frame to which the bar is hinged may be moved for a continuation of the operation."

Claim.—"What I claim as my invention, is the mode of turning saws mounted upon stretchers or otherwise, within the saw gates, by means of feathers or ribs, with the arms or parallel motions connected therewith, and operated by keys, as herein before described.

"And I also claim the mode of determining the bevels of cuts to be made in my said improved sawing machine, by means of a graduated semi-circular board and sliding frame, as hereinbefore described."

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31. For an *Improvement in the Manufacture of Buttons from Straw Board;* Elisha M. Pomeroy, Wallingford, New Haven county, Connecticut, August 21.

The patentee says,—"The nature of my improvement consists in preparing the said buttons for the reception of a coat of varnish, by a newly discovered, and, as is believed, the only practicable method."

Claim.—"What I claim as my invention, is the mode or process of preparing the buttons

aforesaid for the reception of a smooth coat of varnish, which process consists in removing the roughness from the surface of the buttons after baking them a second time, by revolving them in a cylinder with linseed or other fixed oil, and again baking them until the said oil becomes dry and hard, and impervious to the varnish as aforesaid; all substantially in manner and form as above described; which said process is peculiar to the use of straw board in the manufacture of dead-eye buttons, and essential in the use of that material, and whereby an equally good button can be afforded at nearly one-half the cost of the ordinary paper button manufactured by me in the method secured to me by letters patent of the United States, of September 23d, A. D. 1843.

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32. For an *Improvement in Fire Proof Safes;* Edward and Joseph L. Hall, Cincinnati, Ohio, August 21.

Claim.—"What we claim as new, is the manner of joining the interior to the exterior casing, by bolts or rivets imbedded in the insulating cement, substantially as set forth, whereby it is rendered more capable of resisting the action of fire, or external force applied to break it open.

"We likewise claim the employment, in chests so joined by bolts, of hydraulic cement as the insulating material for fire proof safes or chests, it being stronger when concreted than other cements heretofore used for that purpose, and therefore making a safe of superior strength and durability, especially when the same is constructed upon our concrete principle, herein described."

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33. For an *Improvement in Planetariums;* Benjamin O .Swain, Annisquam, Essex county, Massachusetts, August 21.

Claim.—"What I claim as my invention, is as follows: I claim the arrangement of the orbit of each planetary ball, excepting those representing the Earth and Mercury, in a vertical plane, in combination with overloading one side or part of said ball, in such manner that the action of gravity shall operate to rotate the ball once during each revolution of it about the sun, or, in other words, preserve the parallelism of the axis of the ball throughout its entire revolution; the said improvement enabling me to illustrate the seasons at each of the planets excepting the Earth and Mercury.

"I also claim the method of applying the lamp so as to illuminate the globe L, (the Sun,) the same consisting in arranging the lamp on the outside of the globe, and extending the wick tubes into and through an opening made in the globe and around its axis of rotation, as specified.

"I also claim the arrangement of the inferior planets, and the mechanism for operating them, with respect to the Sun and the superior planets, and their operating mechanism; the said arrangement enabling me to get the inclined motions of the inferior planets, and, by so doing, to illustrate the doctrine of the transits. This arrangement consists in placing the machinery, by which the inferior planets are moved, on the opposite side of the Sun to that on which the other planets and their operating machinery are disposed. The vertical zodiac is so arranged that the equinoctial points are in a horizontal line, and the solstitial points in a vertical line; the vernal equinox being on the left, the autumnal falls upon the right.

"The ascending node of Mercury is in the last of the sign Taurus, or in that point of the zodiac which is reached by the Earth on the ninth or tenth of November; the descending node is, of course, at the opposite point. The machinery which operates the planet Mercury, carries it across the plane of the Earth's motion at these points.

"I also claim the combination of mechanism by which the annual and diurnal revolutions of the Earth S are produced, and by which the parallelism of the Earth's axis during its annual revolutions is preserved, the said machinery consisting of the stationary grooved zodiacal wheel, and endless belt thereon, the forked arm, its supporting shaft and rotating mechanism, the pulley, tubular shaft, pinion, gear, cylindrical block and shaft, pulleys and their endless band; the whole being applied to the globe S, and made to operate substantially as specified."

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34. For an *Improvement in the Manufacture of Car Wheels;* Edward Finch, Liverpool, England, August 21.

Claim.—What I claim, is the above described improvement in the manufacture of a wrought iron wheel for railway carriages, viz., by contracting or compressing the tire and its lips down upon a dove-tailed rim while the tire is heated, as specified; whereby the parts are united by a continuous dove-tail joint, as explained, thereby avoiding, in the use of such a wheel, many liabilities to accident to which other wrought iron wheels are subject."

35. For a *Combined Sash and Inside Shutter Fastener;* A. D. Baldwin, assignee of James Bell, City of New York, August 21.

Claim.—"I claim at new, the herein described method of fastening window sashes and inside shutters, by means of two pieces of metal, hinged together, or one entire piece, binding the sashes and shutters by the addition of a plate and screw, so that they can only be opened from the inside; the whole constructed and operating substantially as described."

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36. For an *Improvement in Treenail Machines;* Josiah Kirby, Cincinnati, Ohio, August 21.

The patentee says,—"The nature of my invention consists in making treenails, for shipbuilding and other purposes, by forcing the timber between sharp bits or knives. These bits are arranged on a main head at suitable angles with each other, so as to shave the pin, as it passes through the head, square or otherwise. They are also, by means of a rock-shaft and slide connexions round the head, made to close their edges gradually on the treenail as it is forced through between them, at once squaring and tapering it."

Claim.—"What I claim as my invention, is the combination of the bit with the bit-holder and the head, and the bits, rod, and flanch, constructed and operating substantially in the manner and for the purpose herein described."

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37. For an *Improved Self-Acting Sash Fastener and Stopper;* James C. Cochran, Rochester, New York, August 21.

Claim.—"What I claim as my invention, is the combination of the case, made as described, with the bolt, also made as described, by which the bolt is made to self-act in locking the sash to the window frame, the spiral groove in the case acting against the cog projecting from the periphery of the bolt, to move the latter forward and throw it into the thimble of the frame, as the bolt is turned by the descent of the outer extremity of the handle in the arc of a circle; the bolt being again withdrawn from the thimble, to unlock the sash, by simply raising the outer end of the handle in the same arc of a circle, as set forth."

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38. For an *Improvement in Ice Cream Freezers;* John Decker, Belle Air, Harford county, Maryland, August 21.

The patentee says,—"The nature of my invention consists in locating and securing a tube, A, in the centre of the body of an ice cream freezer, for the reception of the tube B, secured to, and descending from, the cover, for the purpose set forth."

Claim.—"What I claim as my invention, is the location of the tube A within the body of the freezer, and forming a part of the same, when combined with the ice tube B, descending from, and made fast to, the cover, substantially in the manner and for the purpose set forth."

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39. For an *Improved Angular Rotating Tuyere;* Samuel H. Camp, Hartford, Connecticut, August 21.

The patentee says,—"The nature of my invention consists in the employment of a square, rectangular, hollow revolving grate or tuyere iron, for forges, perforated with apertures of different sizes, forming bars in the sides, for regulating the admission of air into the fire of the forge, and for breaking the scale of metal by edges of the grate or tuyere iron, when it is revolved to prevent the tuyere from being choked."

Claim.—"I claim the tuyere, of a square, rectangular, or hexagon form, having edges, and revolving, not on an eccentric axis, but a central axis, to break off the scale formed by the fire upon the metal, by turning round the tuyere, when such tuyere is constructed hollow, and with apertures of different sizes upon its different faces, through which the blast is forced; the whole being constructed substantially as described."

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40. For a *Combined Piston-Breech and Firing-Cock Repeating Gun;* George A. Arrowsmith, assignee of Walter Hunt, City of New York, August 21; anté dated Dec. 10, 1847.

Claim.—"What I specifically claim as new, is the construction of a hollow sliding or piston breech pin, which is operated by a lever in loading and securing the charge in the breech of the gun, which breech-pin, in addition to the above characteristic, contains, or has attached to it, the main spring, firing-cock, or punch, and firing-chamber of the priming.

"I also claim the mode of transferring the priming from the fixed magazine to the firing-chamber, in or by means of the said sliding breech-pin, as above set forth and described."

41. For an *Improvement in Inkstands;* Andrew Fife, Philadelphia, Pennsylvania, August 21.

The patentee says,—"The object of the 'Gold Pen Protector' is to interpose a soft elastic substance between the pen and the hard substances composing the inkstand and its reservoir, in such a way as to greatly decrease, if not entirely remove, the danger of breaking the point of the pen in taking a dip of ink."

Claim.—"What I claim as my invention, is forming the top, or surface surrounding and partially covering the mouth of the reservoir of the inkstand, of gum elastic, or other similar soft elastic substance or composition, substantially in the manner and for the purpose herein described."

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42. For an *Improvement in Dining Tables;* John C. Nichols, Woburn, Middlesex county, Massachusetts, August 21.

Claim.—"I claim, in combination with the rotary tablet A, the supporting pier and tablet B, the mechanism for elevating, depressing, and sustaining the rotary tablet somewhat above the stationary tablet, in manner as described, and for the purpose of preventing plates, dishes, or articles, which may be placed on the tablet B, from improperly interfering with the movements of the rotating tablet.

"Furthermore, I claim the manner described of constructing and combining the leaves and middle parts of the two tablets, whereby the two leaves on each side of the centre of the table may be simultaneously and together turned down into a vertical position, so as to cause the table to have advantages usually possessed by a common two-leaved table."

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43. For *Improvements in Rotating Spike Machines;* Edwin B. White, Nashua, Hillsborough county, New Hampshire, August 28.

Claim.—"What I claim as my invention, is as follows: that is to say, I claim, in combination with the movable gauge and pointing dies, the ducts or passages made in the gauge, for the distribution of the water on the dies, as described.

"I also claim the hopper and its slide, in combination with the conductor and its movable frame, the whole being made to operate together substantially as above explained."

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44. For an *Improvement in Planing Machines;* Reid R. Throckmorton, Brooklyn, New York, August 28.

The patentee says,—"The nature of my invention consists in giving to the planing bits two motions in the opperation of planing, viz., a rotary motion about an axis, and a reciprocating motion across the face of the board, that the planes, while acting on the board, may generate a curve due to these two motions instead of a segment of a circle, and give what is termed a draw-cut."

Claim.—"What I claim as my invention, is giving to the plane irons, in passing over the board, a compound motion, one around the axis of their shaft, and the other rectilinear reciprocating, substantially as described, by giving to the shaft that carries the face wheel a rectilinear reciprocating motion, in combination with a rotary motion, in the operation of planing, substantially as described."

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45. For an *Improvement in Machinery for Cutting Screws in Bedsteads;* Joseph Garside and Henry J. Betjemann, Harrison, Hamilton county, Ohio, August 28.

Claim.—"What we claim as our invention, is the combination of the driver or clearer with the hollow cylinder tap, for keeping the cutter clear of chips during the operation of cutting the female screw in posts for bedsteads, and for other purposes, substantially as described."

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46. For a *Method of Connecting the Hammer with the Cylinder of a Revolving Fire Arm;* Edwin G. Ripley, administrator of Edwin Wesson, Hartford, Connecticut, August 28.

Claim.—"What I claim as new, is the employment of the bevel gear introduced into the lock, substantially in the manner and for the purposes set forth, so that two or more chambers can be employed in the cylinder, and chambers of any desired calibre, by changing the relative proportions of the gear, without changing the motion of the hammer."

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47. For an *Improvement in Machinery for Dressing Treenails;* Jesse Fitzgerald, City of New York, August 28.

Claim.—"What I claim as my invention, is the combination of the cutters with the enlarging and heading apparatus, viz., the cam, the elevating piece T, with *f*, U, and *h*."

48. For an *Improvement in Sugar Pans;* Alfred Stillman, City of New York, August 28.

The patentee says,—"The nature of my invention consists in connecting the two domes of the pan by means of a pipe above the top of the pan, with the end in the first dome turned up to prevent, in part, the foam from the liquid to pass up into the pipe, and turned down in the second dome, for the free discharge of the liquid particles which may be carried over by the vapor."

Claim.—"What I claim as my invention, is connecting the two domes of the evaporating pan by means of a pipe above the top of the pan, the end of which, in the second dome, is turned down, substantially in the manner and for the purpose described, whether the said pipe be inclined downwards from the first to the second dome, or be horizontal, as described."

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49. For an *Improvement in Fountain Pens;* David O. Macomber, City of New York, August 28.

The patentee says,—"My improvements consist in simple means for so applying and regulating the hydrostatic pressure of the fluid, that each pen is portable, safe, and always ready for use."

Claim.—"What I claim as new, is the application of a conical metal point or plug, acting in a conical tube set eccentrically with the axis of the main tube, for the three purposes of guiding the ink to the nibs of the pen, of regulating the supply of ink, and for securing the ink in the tube when not in use, substantially as described and shown."

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50. For a *Method of Working the Air Pump, and Using a Condensing as a Non-Condensing Engine;* R. F. Loper, Philadelphia, Pennsylvania, August 28.

The patentee says,—"The nature of my improvement consists in the arrangement of the engine within a vessel for propelling, and the peculiar combination of the air pump therewith, together with the method of converting the engine at once into a condensing or non-condensing engine."

Claim.—"What I claim as my invention, is, 1st, the combination of the air pump with the engine, in the manner set forth, by which I work it more easily, and reduce the number of actions of the valves one-half less than can be done in the ordinary way; I also claim the arrangement for converting the engine into a condensing or non-condensing engine, by opening or closing a free vent for the steam from the condenser, as set forth."

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51. For an *Improvement in Bedstead Fastenings;* Simeon Hovey, Painesville, Lake county, Ohio, August 28.

The patentee says,—"The nature of my invention consists in inserting in each post of a bedstead a socket iron, with which the tenons of two adjacent rails are engaged."

Claim.—"I claim the mode of holding in the block of metal containing the catches or locks into which the contiguous end of the rails are locked, whereby the metal has a firm bearing against the wood of the inner corner of the post, on whichever rail the strain of the pulling comes, as described."

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52. For a *Combined Construction and Operation of the Drill in Rock Drilling Machines;* George N. Doan, Millerstown, Perry county, Pennsylvania, August 28.

Claim.—"What I claim as my invention, is giving to a drill, having its cutting edges beveled as herein described, a compound longitudinal and rotary motion, substantially in the manner and for the purposes described, but irrespective of the devices by which said compound motion is produced."

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53. For a *Gold Washer;* Michael English, Lagro, Wabash county, Indiana, August 28.

Claim.—"What I claim as new, is the combination of the helical revolving screen, with the dashers upon its periphery, and the conical frustrum with a screw therein, by which arrangement the larger and smaller particles are separated, and the latter washed, at one operation; all of which is arranged substantially in the manner and for the purpose set forth."

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54. For an *Improvement in Hill-Side Ploughs;* John W. Thurman, Buchanan, Lewis county, Virginia, August 28.

The patentee says,—"My invention consists in attaching a right and left-hand mould-board, with their respective shares, &c., to the opposite sides of a revolving shaft extending across

the beam, so that they may be turned to place either share beneath the beam, where it is secured by a sliding stop in the proper position to turn the furrow, which may thus be thrown to the right or left as the operator desires."

Claim.—"What I claim as my invention, is the double or right and left-hand mould-boards, revolving upon a horizontal shaft placed across the beam, as herein described, using for that purpose cast or wrought iron, or any other material that will answer the desired purpose."

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55. For an *Improvement in Straw Cutters;* Lewis Tupper, Auburn, Cayuga county, New York, August 28.

The patentee says,—"The nature of my invention consists of the arrangement of two long lever rods, on opposite sides of the straw-cutting machine, in combination with levers and clicks that operate on ratchet wheels on the ends of the feeders or rollers for carrying the straw or hay forward under the knife, in the operation of cutting, the straw or hay being cut off in equal lengths by a knife that slides vertically, and is moved by a crank in gear with it.

Claim.—"I claim the combination of the reciprocating arms with the ratchet levers or clicks, in the manner substantially as described, and for the purposes set forth."

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56. For an *Improvement in Threshing Machines;* Abram Bloom, Newville, Cumberland county, Pennsylvania, August 28.

The patentee says,—"The nature of my invention consists in the application of adjustable teeth to the concave, by which the dimensions of the spaces through which the straw passes are regulated according to the nature of the material to be operated upon."

Claim.—"What I claim as my invention, is the employment of adjustable teeth, turning upon pivots, on the concave of threshing machines, substantially in the manner and for the purpose herein described."

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57. For an *Improvement in Spinal Supporters;* Henry G. Davis, Millbury, Worcester county, Massachusetts, August 28.

Claim.—"I claim as my invention and discovery, the combination and arrangement of the steel plates, and the bands, combined as occasion requires with a band or bands F, all the parts being so formed as to be capable of being united, in the manner and for the purposes set forth in the specification, and constituting, when so in union, a machine which gives support to the body, when afflicted with any disease which makes such support useful."

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58. For an *Improvement in Chucks;* James W. Martin and Edwin Parry, Northern Liberties, Philadelphia county, Pennsylvania, August 28.

Claim.—"What we claim as our invention, is the arrangement and application of two or more geared sectors, or toothed wheels, with the jaws or pins affixed and meshing into a pinion, as described, in combination with the spur wheel and screw."

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59. For an *Improvement in Spring Seat Saddles;* Robert Smith, Leesburg, Cumberland county, Pennsylvania, August 28.

The patentee says,—"The nature of my invention consists in giving great elasticity to the seat of the saddle by an arrangement of springs attached to the tree; the weight of the rider is sustained on spring steel strips; these are not only elastic in themselves, but are rendered additionally so by an elliptic spring concealed in the cantle."

Claim.—"What I claim as my invention, is the combination of the elastic strips, for supporting the seat, with the spring contained in the cantle of the saddle-tree, substantially in the manner set forth."

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60. For a *Machine for Bending the Lips of Wrought Iron Railway Chairs;* Matthias P. Sawyer and John W. Hall, Boston, Massachusetts, assignees of Samuel A. Cox, Malden, Middlesex county, Massachusetts, August 28.

Claim.—"What I claim as my invention, is the combination of the former, the bending levers, or bending apparatus, and the base block for supporting the chair blank; the whole being constructed and made to operate together essentially in the manner and for the purpose specified; the drop hammer being employed in combination with the former, the base block, and bending apparatus, substantially as described."

61. For an *Improvement on Graduating Carpenters' Squares;* Dennis J. George and Norman Millington, South Shaftsbury, Bennington county, Vermont, August 28.

The patentees say,—"The nature of our improvement consists in providing as many chases as we desire to impress different configurations on the different sides of the bar and tongue of the square, which chases are filled up with properly fitted steel dies, after the manner of printing types, being correctly graduated, so as to make all the divisions and sub-divisions suitable for the sides upon which the impression is to be made, and then placing the side of the square on to the face of the dies, and passing it under the roller press to give the impression."

Claim.—"What we claim as our invention, is, 1st, the method of spacing or graduating metallic squares or rules with steel types or dies, and with or without figures, in combination with the roller press, suspended in a frame, so that the weight or pressure shall be brought below the centre, and as near the plane of the periphery of the roller as may be consistent with strength to bear the pressure.

"2d, The arrangement of the roller, frame, and yoke, so as to be raised or lowered by the lever, all as above specified, and for the purposes therein mentioned."

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62. For an *Improvement in Machinery for Jointing Staves;* Samuel Jobes, Moundsville, Marshall county, Virginia, August 28.

The patentee says,—"The nature of my invention consists in giving an oscillating motion to the stave carriage, while the stave upon it is acted upon by a double-ironed plane, in such manner that, while the proper bevel is given to the stave, it, at the same operation, receives the proper taper in each direction from its centre."

Claim.—"What I claim as my invention, is combining an oscillating stave carriage with a reciprocating plane, in such manner that the former shall be operated by the latter, substantially in the manner herein set forth."

Additional Improvement for August, 1849.

1. For an *Improved Lever Scale for Canals, Railroads, &c.;* Ely Ellicott and Samuel A. Abbott, Philadelphia, Pennsylvania; patented February 6, 1849, additional improvement annexed August 14.

The patentees say,—"The nature of our improvement consists in placing on the top or base of the lock, dock, canal, or other desired place, two chairs or supports, at proper distances apart, to keep in position the suspended levers, (which are angular or bell-crank levers having fulcrums,) and running on each side of said lock, dock, railroad, &c., which angular or bell-crank levers give the first action to the scale, and by the multiplication of said levers and chairs, the scale may be extended to any required length, and by placing at one end of the scale a reversed angular lever, the proper action will be given to the beam, and dispensing with the simple levers, as described in our patent dated the sixth day of February, 1849."

Claim.—"What we claim as new, is two angular or bell crank levers, in combination with a reversed angular lever, to be connected together by rods, substantially as herein described, and placed on each side of the top or base of a lock, dock, canal, or other desired place; said lever to be connected to a graduated beam, and by the multiplication of which levers, a scale may be formed strong enough for any purpose, and weighing with entire accuracy; dispensing with the right or horizontal levers, as described in our letters patent for improved lever scale, which letters patent are dated February 6, 1849.

Re-Issue for August, 1849.

1. For an *Improvement in the Manufacture of India Rubber Goods by means of Zinc Compounds;* Henry G. Tyer and John Helm, New Brunswick, Middlesex county, New Jersey; patented January 30, 1849, re-issued August 7.

The patentees say,—"The nature of our invention consists in forming a compound of caoutchouc, carbonate of zinc, or other preparations of that metal, as hereinafter mentioned, with sulphur, which is perfectly elastic, impermeable to air or water, unchangeable in extreme temperatures, preserving its color without 'bloom,' and free from the deadly action upon the constitution and health hitherto experienced by the operatives employed in the preparation of metallic or vulcanized rubber."

Claim.—"What we claim as our invention, is India rubber fabrics, made by the combination of caoutchouc in its several varieties with zinc compounds in their several forms, as

herein set forth, and sulphur, and, in combination with these, the submitting our compound to the action of a high degree of heat; the whole being combined and manufactured substantially as described."

Designs for August, 1849.

1. For a *Design for Stoves;* Joseph G. Lamb and Conrad Harris, Cincinnati, Ohio, August 7.
2. For a *Design for Stoves;* Pease, Keeney & Co., assignees of William L. Sanderson, Troy, New York, August 21.

The claim to each of the above patents is for the designs as represented in the specifications.

List of American Patents which issued in September, 1849, with Exemplifications by Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improvement in Spring Mattresses;* Patrick O'Neil, Philadelphia, Pennsylvania, September 4; anté dated August 4.

Claim.—"What I claim as my invention, is the mode of regulating the elasticity of the mattress, so as to increase or diminish the pressure on any part of the person using it, by the means and for the purposes hereinabove described. Furthermore, I claim the use of the bolts and the tubes, substantially in the manner and for the purposes set forth."

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2. For an *Improvement in Bedstead Fastenings;* James Taylor, Macon, Bibb county, Georgia, September 4.

Claim.—"What I claim as my invention, is the nuts for tightening and loosening the hooks upon the bars, substantially as set forth."

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3. For an *Improvement in Axles for Carriages;* John J. Flack, Joliet, Will county, Illinois, September 4.

The patentee says,—"The principle object of said improvement is to do away with friction, so that any given weight can be moved or transported with a comparatively small power, or that a comparatively small power will serve to move or transport any given weight, with much more ease and facility than it can be done without such improvement."

Claim.—"What I claim as my invention, is making the axle concavo-convex, combined with the friction rollers placed in the concavities thereof, in such a manner that the rollers shall protrude from the underside of the axles, downward, and rest upon the boxes in the hub, (the upper side of the said friction rollers are never to come in contact with the concavity of the axles,) having the whole load or burden supported by the rollers, and thereby save a large amount of friction which occurs in using the common or sliding axles."

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4. For an *Improvement in Brakes for Railroad Cars;* Horace T. Robbins, Lowell, Middlesex county, Massachusetts, September 4.

Claim.—"What I claim as my invention, is the adjustable chisel in its combination with the brake-tread of each brake, the same being made to operate in manner and for the object specified.

"And I also claim the combination of mechanism for elevating the treads of the brakes from the rails, the same consisting of the shaft, the parts constituting the clutch, and the levers, chains, and windlasses connected therewith, the whole being applied together and made to operate essentially as described."

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5. For a *Machine for Crushing Ice;* Alfred C. Hobbs and John Brown, City of New York, September 4.

The patentees say,—"Our improvements consist in applying a hopper, with one diagonal fixed side and two parallel sides, to contain the ice, and compressing the ice by a movable fourth side, the fixed diagonal side and moving side having within them dental projections cut or cast on, to operate downwards, and prevent the ice rising in the hopper when com-

pressed, and also enter and split the ice, and the combination with these parts of a lever fitted with an eccentric or cam-formed point, the power of which lever is greatest at commencing the compression, when the mass of ice offers the greatest resistance, and the point or centre, supporting the moving side of the hopper, being set away from the vertical line forming the common centre of the hopper, the motion given by the lever brings the moving diagonal side nearer to a parallel line with the fixed diagonal, and compresses the ice between them, so as to crush it, precisely in the manner that it would be crushed between the jaws of a living animal."

Claim.—"We claim as new, the application of a dental-faced crushing side to a hopper, such face being movable in a centre eccentric with the body of the machine, such application being made in combination with a cam-pointed lever, formed as described and shown, when such application and combination is used for the purpose of crushing and pushing out the ice by the same movement which crushes it, and, while crushing, presses hardest while the mass of ice is strongest; the whole operating substantially as described and shown."

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6. For an *Improvement in Machines for Weaving Harness for Looms;* Simeon Holton, Jr., and William R. Harris, Middlebury, Addison county, Vermont, September 4.

The patentees say,—"The nature of our invention and improvement consists in combining, arranging, and operating certain mechanism, in such manner as to form weavers' harness by machinery, instead of other means heretofore used."

Claim.—"What we claim as our invention, is the method of making weavers' harness by power machinery, substantially as described, whether the carriage containing the harness frame, and the shuttles containing the twine, be operated by the combination of mechanism described, or any other which may be substantially the same, and by which analogous results are produced."

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7. For an *Improvement in Machines for Cutting Paper;* William Johnson, assignee of Alonzo Gilman, Troy, New York, September 4.

Claim.—"What I claim as new, is the combination and arrangement of the guide-bar, slide-rest, and adjustable cutter, in connexion with a press or clamp for securing the paper so cut, in the manner and for the purpose substantially as set forth."

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8. For an *Improvement in Apparatus for Operating Shuttle Boxes for Looms;* Charles J. Gardner, Northern Liberties, Philadelphia county, Pennsylvania, assignee of Andrew Allen, Wilmington, New Castle county, Delaware, September 4.

The patentee says,—"The nature of my invention consists in providing and affixing a lever to the plain power loom, with a shoe attached to said lever, that rises and falls by means of studs affixed in a circular dial plate, thus raising and lowering the shuttle boxes by means of a rod connecting with said lever and the box rod, which enables the operator to weave any desired pattern of check or stripe."

Claim.—"What I claim as my invention, is the wheel, having apertures (or other devices for holding the studs) arranged in radial lines, or nearly so, in combination with the movable studs and the shoe, or its equivalent, upon the weighted lever, for raising the shuttle box, and allowing them to fall, substantially as set forth."

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9. For an *Improvement in Moulds for Making Glass Pipes;* D. O. Ketchum, assignee of George Scott, Albany, New York, September 4.

Claim.—"What I claim as my invention, is not simply the invention of a mould for blowing glass, but I claim the invention of a mould of the shape above described, open at each end, placed in a horizontal position, expressly for blowing uniform glass water pipes."

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10. For an *Improvement in Machines for Cutting Welts;* Samuel Keen, Jr., East Bridgewater, Plymouth county, Massachusetts, September 4.

Claim.—"What I claim as my invention, is the application of a gauge or gauges to a skiver, whereby welts for boots and shoes may be formed substantially in the manner described."

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11. For *Improvements in Eccentric Sash Fasteners;* Lewis B. Page, Hartford county, Connecticut, September 4.

The patentee says,—"The nature of my improvement consists in a self-acting cam whose

edge is notched; by the action of this cam the sash can be held in any position, and securely locked at its lowest, without being affected by any inequalities in the sash frame."

Claim.—"What I claim as my invention, is the combination of the spring with the notched cam, whereby the latter is rendered capable of holding the sash where the simple cam would be insufficient, and is also forced to enter the slot for locking the window."

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12. For an *Improvement in Machines for Turning Leaves of Books;* J. H. Schomacker and Martin Kuermerle, Philadelphia, Pennsylvania, September 4.

Claim.—"What we claim as our invention, is, 1st, the arms with their fingers, in combination with the lever operated by the circular or coiled spring, and the slide and cord, in the manner and for the purposes set forth.

"2d, The catch plate, with its graduating screw, and the guard attached to the lever, for the purpose of catching the pendents, as described.

"3d, In the lever, so combined with the catch plate and guard, we claim the joint, guide, and longitudinal spring, for the purpose set forth.

"4th, The combination of the pillar, washers, rings, and pin, to form independent bearings for the several arms, as described."

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13. For a *Method of Reversing Re-Acting Rotary Engines;* C. M. Miles, Brockwayville, Jefferson county, Pennsylvania, September 4.

The patentee says,—"The nature of my invention consists in the construction of a rotary steam engine, the peculiar and important feature of which is the employment of an escape tube, having two reversed elbows at its extremeties, enlarged towards their mouths like a trumpet, thus affording an opportunity of great and rapid expansion to the steam, which thereby gives motion to the engine by counter pressure."

Claim.—"I claim the mode of reversing the motion of the engine, by a rack passing through the shaft thereof, and meshing into a pinion on the revolving nozzles, in the manner substantially as described."

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14. For *Improvements in Street-Sweeping Machines;* Calvin S. Bishop, Easton, Northampton county, Pennsylvania, September 4.

Claim.—"What I claim as my invention, is, 1st, arranging two brush wheels abreast in the same machine, substantially as described and for the purposes stated.

"2d, I claim the articulated inflected sweeping plane, composed of two or more curved or inflected sections, attached to the carriage in such a manner that each section may have either a transverse, vertical, or undulatory motion, substantially as described; and this I claim whether such sections be connected to each other, as described, or irrespective of such attachment."

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15. For an *Improvement in Cooking Stoves;* David Johnston, Amsterdam, Jefferson county, Ohio, September 4.

Claim.—"What I claim as my invention, is the movable back plate, and top plate containing boiler holes, constructed, arranged, and combined, substantially in the manner and for the purposes designated."

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16. For an *Improvement in Machines for Making Wire Heddles;* Abijah J. Williams, Utica, New York, September 11.

The patentee says,—"The nature of my invention and improvement consists in a certain new and useful combination and arrangement of mechanical devices, by which a continuous piece of wire is cut off from the skein of wire on the reel, as it is fed into the machine between rollers, and seized by a hook at the middle of its length, and doubled or folded whilst being drawn into the cylinders, where it is held firmly by pincers and vibrating teeth passing between the strands, whilst the cylinders are made to revolve and twist the wires and form the heddles, and then cause the pincers to open, withdraw the vibrating teeth, and discharge the heddles in a finished state."

Claim.—"What I claim as my invention, is the before described mode of making wire heddles from a skein or hank of wire, by power machinery, by cutting the wire as it is fed into the machine, into suitable lengths to form, when doubled, the required heddles, and to drop said wires separately on to a horizontal reciprocating feeding and discharging hook-rod, by which each wire is doubled into two strands, and drawn into the centre of two revolving cylinders turning in contrary directions, wherein the strands are held by pincers and vibrating teeth forced between them, until they are twisted into the form of the required heddle, when

the heddle is discharged from the face of the cylinders by the reciprocatory movement of the hook-rod; the movements of the several parts of the machine to effect the aforesaid object being produced by a combination and arrangement of mechanism similar to that herein described, or any other which may be substantially the same, and by which analogous results are produced."

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17. For an *Improvement in Can Hooks;* George Webber, Portland, Maine, September 11.

The patentee says,—"The nature of my invention consists in providing a fulcrum bar, in combination with diagonal jaw-levers, so that each jaw-lever has a fulcrum in the bar, thereby giving this machine more lever to grasp and retain blocks of wood, ice, or stone, than if the two jaw-levers were united and combined by a bolt passing through them where, or at a part where, they intersect each other."

Claim.—"What I claim as new and useful, is the combination of the fulcrum bar with the jaw-levers, for the purpose and in the manner substantially as described."

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18. For an *Improvement in Cotton Gins;* Stephen R. Parkhurst, City of New York, September 11.

Claim.—"What I claim as my invention, is the combination of the toothed cylinder with the screw cylinder, both having their outer surface formed substantially as described, and working together in the manner and for the purpose above set forth. I am aware that toothed cylinders have heretofore been essayed in connexion with grooved rollers for ginning cotton, but when this has been done, the grooves have been made directly around the cylinder, or, if spiral, have been arranged in lines so nearly parallel with the axis of the cylinder as to operate like beaters, or to force the bolls so rapidly to the end of the toothed cylinder as to prevent them from being properly ginned. I, therefore, do not claim the toothed cylinder in combination with such grooved cylinders, but only with those having small spiral grooves around their surfaces, running nearly at right angles to the axis thereof, substantially as described.

"I am also aware that card cylinders have been used in connexion with toothed cylinders to strip off the cotton, but in such cases the advantage of delivering the cotton by a current of air directly through an opening is not attained. And I am also aware that brushes, attached to the ends of the arms or fans of blowers, have been used in connexion with toothed cylinders, to brush the cotton therefrom, to be thence passed out through an exit mouth in the case of the blower; but in such cases the cotton, when brushed from the cylinder, is rolled and becomes knobbed on the ends of the brushes, and tends to fall upon the bottom of the case of the blower. But in my said invention, the cards on the ends of the arms or fans hook the cotton from the toothed cylinder, and carry it forward without rolling or knobbing it, or allowing it to drop, until it reaches the exit mouth, where it is slipped off the teeth by the current of air, and carried through the opening to any convenient receptacle, with the fibres free from rolls and knobs. I, therefore, also claim the blower, constructed with cards on the arms or fans, in combination with toothed ginning cylinder and exit mouth, substantially as described and for the purpose set forth."

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19. For a *Machine for Forming the Eyes of Hinges;* David W. Lyon, West Troy, Albany county, New York, September 11.

The patentee says,—"The nature of my invention consists in certain presses and levers, by which to bind the blank and form the eyes of the hinges."

Claim.—"What I claim as my invention, is the lever, formed and made to move in a compound direction, essentially in the manner herein described, in combination with the spring slide, by the joint action of which the eye of the hinge may be turned."

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20. For an *Improvement in Jointed Pawls;* Samuel S. Walley, Philadelphia, Pennsylvania, September 11.

Claim.—"What I claim as my invention, is the combination of the pawl with the lever resting upon the timber and connected to the post, forming a jointed pivot pawl, arranged and operated in the manner and for the purpose set forth, together with the mode of holding down the lever by a rope, as aforesaid, as substantially applied to the purposes of a pawl, by which the advantages named are gained."

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21. For an *Improvement in Straw Cutters;* Thomas and Edward Burrell, Seneca, Seneca county, New York, September 11.

Claim.—"What we claim as new, is, 1st, the employment of four feeding rollers, in the

manner described, the top hind roller having spikes on its surface, to hold firmly the straw, &c., and the combination of the said four rollers, to feed in the straw or stalks with a steady uniform motion, so that the action of the cutter wheel will not arrest the motion of the sheet of stalks, &c., when fed in to the knives, however great the speed of the cutter wheel may be.

"2d, We claim the cylinder-fluted pinion wheels, in combination with the upper face cog wheels, to allow the top rollers to rise up and slide down, when different thicknesses of stalks, &c., are fed into the cutters, this being a superior manner of gearing to accomplish this object, and avoid all breakage of cogs in the wheels, for the purposes set forth."

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22. For an *Improved Machine for Polishing Knives;* Asa Munger and Royal C. Taylor, Auburn, New York, September 11.

The patentees say,—"Our invention consists in introducing the polishing substance into a hollow drum, in which it is ground, and from which it is fed between the adjoining faces of two revolving concentric disks of leather, or other flexible substance, one of which is attached solidly to a central shaft; the other is movable on the shaft, and is pressed against the first by a star-shaped spring, in such a manner that it shall close before and behind a knife inserted between the two, and prevent the polishing powder from being wasted."

Claim.—"What we claim as our invention, is the grinding drum and sieve, and polishing surfaces, arranged on one shaft, whereby the several operations of grinding, sifting, and feeding the polishing material, and polishing the cutlery, are simultaneously performed in a simple and convenient manner."

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23. For an *Improvement in Registers for Hot Air Furnaces;* Charles F. Tuttle, Williamsburg, Kings county, New York, September 11.

The patentee says,—"The nature of my invention consists in the new and improved method of opening and closing the valves of hot air registers and ventilators, by means of a slide piece, placed either at the top or at one end of the register, the said slide piece being connected to the valves by means of connecting rods that work with a joint at their point of connexion with the slide, and also with a joint at their point of connexion to the valves, one end of the connecting rod moving in a circular direction, corresponding to the motion of the valves moved, constructed so as to seriously diminish the friction in opening."

Claim.—"What I claim as my invention, is the combination of the slide piece and the connecting rod or rods, for the opening and closing of hot air registers and ventilators, the said connecting rod or rods being so joined to the slide piece as to form a joint at the place of connexion, the said connecting rod or rods also forming a joint at their point of connexion to the valves or arms thereof, causing the end of the rods joined to the valves to move in a circular direction, corresponding to the motion of the valves when moved."

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24. For an *Improvement in Parallactic Instruments for Measuring Distances;* William Würdemann, City of Washington, D. C., September 11.

The patentee says,—"The principle of my invention consists in thus mounting a telescope, provided with a micrometer eye-piece, that two positions, as nearly as possible parallel to each other, may be given to it. The distance of the two positions from each other, which is invariable, furnishes the base, which being transferred, by means of the micrometer, crosswise to the object whose distance is to be measured, appears in the field of the telescope of a magnitude in an exact inverse proportion in relation to the distance.

"This magnitude being measured by means of the micrometer, the angle of parallax is thereby obtained, from which the distance may be calculated, or, more conveniently, read off from a table previously prepared for the instrument."

Claim.—"What I claim as my invention, is mounting a telescope, furnished with a micrometer, upon an axis parallel to its line of collimation, as herein described, whereby the telescope can be made, with facility and accuracy, to take two parallel positions at the extremities of a given base line, for the purpose of measuring the distance of a remote object by means of the parallactic angle thus obtained by the micrometer."

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25. For an *Improvement in Machines for Breaking Hides;* Isaac S. Hershey, Hagerstown, Washington county, Maryland, September 11.

Claim.—"What I claim as my invention, is the before described combination of right and left revolving helical breakers, constructed and operated substantially as set forth, for breaking or softening hides."

To be Continued.

MECHANICS, PHYSICS, AND CHEMISTRY.

On an Equation between the Temperature and the Maximum Elasticity of Steam and other Vapors. By WILLIAM JOHN MACQUORN RANKINE, *Civil Engineer.* (WITH A PLATE.)*

Continued from page 125.

TABLE II.—*Vapor of Water.*

Formula for calculating the Maximum Elasticity of Steam (P), from the Temperature on the Air Thermometer, measured from the Absolute Zero (t):

$$\text{Log. P} = \alpha - \frac{\beta}{t} - \frac{\gamma}{t^2}$$

Inverse Formula for calculating the Temperature from the Maximum Elasticity of Steam:

$$\frac{1}{t} = \sqrt{\frac{\alpha - \text{Log. P}}{\gamma} + \frac{\beta^2}{4\gamma^2}} - \frac{\beta}{2\gamma}$$

Values of the Constants depending on the Thermometric Scale.

For the Centigrade Scale:—
Absolute zero 274°·6 below the freezing point of water.

$\text{Log. } \beta = 3{\cdot}1851091$ $\qquad$ $\text{Log. } \gamma = 5{\cdot}0827176$

$\frac{\beta}{2\gamma} = 0{\cdot}0063294$ $\qquad$ $\frac{\beta^2}{4\gamma^2} = 0{\cdot}00004006$

For Fahrenheit's scale; boiling point adjusted at 29·922 inches:—
Absolute zero 462°·28 below ordinary zero.

$\text{Log. } \beta = 3{\cdot}4403816$ $\qquad$ $\text{Log. } \gamma = 5{\cdot}5932626$

$\frac{\beta}{2\gamma} = 0{\cdot}0035163$ $\qquad$ $\frac{\beta^2}{4\gamma^2} = 0{\cdot}000012364$

For Fahrenheit's scale; boiling point adjusted at 30 inches.
Absolute zero 461°·93 below ordinary zero.

$\text{Log. } \beta = 3{\cdot}4400625$ $\qquad$ $\text{Log. } \gamma = 5{\cdot}5926244$

$\frac{\beta}{2\gamma} = 0{\cdot}0035189$ $\qquad$ $\frac{\beta^2}{4\gamma^2} = 0{\cdot}000012383$

Values of the Constant α, depending on the Measure of Elasticity.

For millimetres of mercury	$\alpha = 7{\cdot}831247$
English inches of mercury	6·426421
Atmospheres of 760 mil. = 29·922 inches = 14·7 lbs. on the square inch = 1·0333 kil. on the centimetre^2	4·950433
Atmospheres of 30 inches = 761 mil. ·99 = 14 74 lbs. on the square inch = 1·036 kil. on the centimetre^2	4·949300
Kilogrammes on the square centimetre	4·964658
Pounds Avoirdupois on the square inch	6·117817

N B.—All the Constants are for *common logarithms.*

I have applied similar formulæ to the vapors of *alcohol* and *ether*, making use of the experiments of Dr. Ure.

In order to calculate the constants, the following experimental data have

* From the Edinburgh New Philosophical Journal, for July, 1849.

been taken, assuming that, on Dr. Ure's thermometers, 180° were equal to 100 centigrade degrees.

	Temperatures on Fahrenheit's Scale from the ordinary zero.	Temperatures on Fahrenheit's Scale from the absolute zero.	Pressures in Inches of Mercury.	Remarks.
For Alcohol of the specific gravity 0·813,	250·00	712·30	132·30	From Dr. Ure's Table.
	173·00	635·30	30·00	Do.
	111·02	573·32	6·30	Interpolated in the same Table.
For Ether, boiling at 105° F., under 30 in. pressure,	200·00	662·30	142·80	From Dr. Ure's Table.
	148·80	611·10	66·24	Interpolated.
	105·00	567·30	30·00	From the Table.
For Ether, boiling at 104° F., under 30 inches,	104·00	566·30	30·00	From Dr. Ure's Table.
	66·70	529·00	13·76	Interpolated.
	34·00	496·30	6.20	From the Table.

The values of the constants in equation (1.), calculated from these data, are as follows, for inches of mercury and Fahrenheit's scale:—

	α	Log. β.	Log. γ.
Alcohol, specific gravity, 0·813, . . .	6·16620	3·3165220	5·7602709
Ether, boiling point, 105° F.	5·33590	3·2084573	5·5119893
Ether, boiling point, 104° F.	5·44580	3·2571312	5·3962460

Absolute zero 462°·3 below ordinary zero.

The curves represented by the formulæ for those three fluids are laid down on the diagram which accompanies this memoir (Plate 2), and which, in the engraving, has been reduced to one-fourth of the original scale. The horizontal divisions represent the scale of Fahrenheit's thermometer, numbered from the ordinary zero;—the vertical divisions, pressures of vapor, according to the scales specified on the respective curves. The points corresponding to the experimental data are surrounded by small circles.

The curve for alcohol extends from 32° to 264° of Fahrenheit. It is divided into two portions, having different vertical scales, suitable to high and low pressures respectively.

The curve for the less volatile ether extends from 105° to 210°; that for the more volatile ether, from 34° to 104°.

The results of Dr. Ure's experiments are marked by small crosses.

The irregular and sinuous manner in which these crosses are distributed, indicates that the errors of observation, especially at high temperatures, must have been considerable. This does not appear surprising, when we recollect how many causes of uncertainty affect all the measurements required in such experiments, especially the thermometric observations, and how little those causes have been understood until very recently. The

data from which these constants have been calculated, are, of course, affected by the general uncertainty of the experiments.

When those circumstances are taken into account, it is obvious from inspection of the diagram, that the curves representing the formulæ agree with the points representing the experiments, as nearly as the irregularity of the latter and the uncertainty of the data permit; and that there is good reason to anticipate, that, when experiments shall have been made on the vapors of alcohol and ether with a degree of precision equal to that attained by M. Regnault in the case of the vapor of water, the equation will be found to give the elasticities of those two vapors as accurately as it does that of steam.

Although the diagram affords the best means of judging of the agreement between calculation and experiment, three Tables (III., IV., and V.) are annexed, in order to shew the numerical amount of the discrepancies at certain temperatures. The data, as before, are marked with asterisks.

It is worthy of remark, in the case of alcohol, that although the lowest of the experimental data is at the temperature of 111°·02, the formula agrees extremely well with the experiments throughout the entire range of 79° *below* that point.

TABLE III.—*Vapor of Alcohol, of the Specific Gravity* 0·813.

Temperature in Degrees of Fahrenheit from the ordinary zero.	Pressures in Inches of Mercury according to		Differences between Calculation and Experiment in inches.	Corresponding Differences of Temperature.
	The Formula.	Dr. Ure's Experiments.		
32°·00	0·41	0·40	+ 0·01	− 0°·5
40·00	0·57	0·56	+ 0·01	− 0·4
50·00	0·84	0·86	− 0·02	+ 0·7
60·00	1·22	1·23	− 0·01	+ 0·2
70·00	1·74	1·76	− 0·02	+ 0·3
80·00	2·43	2·45	− 0·02	+ 0·2
90·00	3·36	3·40	− 0·04	+ 0·4
100·00	4·56	4·50	+ 0·06	− 0·5
110·00	6·12	6·00	+ 0·12	− 0·7
*111·02	6·30	6·30	0·00	0·0
120·00	8·10	8·10	0·00	0·0
130·00	10·61	10·60	+ 0·01	− 0·0
140·00	13·73	13·90	− 0·17	+ 0·5
150·00	17·60	18·00	− 0·40	+ 0·9
160·00	22·32	22·60	− 0·28	+ 0·5
170·00	28·06	28·30	− 0·24	+ 0·4
*173·00	30·00	30·00	0·00	0·0
180·00	34·96	34·73	+ 0·23	− 0·3
190·00	43·21	43·20	+ 0·01	− 0·0
200·00	52·96	53·00	− 0·04	+ 0·0
210·00	64·47	65·00	− 0·53	+ 0·5
220·00	77·92	78·50	− 0·58	+ 0·4
230·00	93·54	94·10	− 0·56	+ 0·4
240·00	111·58	111·24	+ 0·34	− 0·2
*250·00	132·30	132·30	0·00	0·0
260·00	155·98	155·20	+ 0·78	− 0·3
264·00	165·58	166·10	− 0·52	+ 0·2
[1.]	[2.]	[3.]	[4.]	[5.]

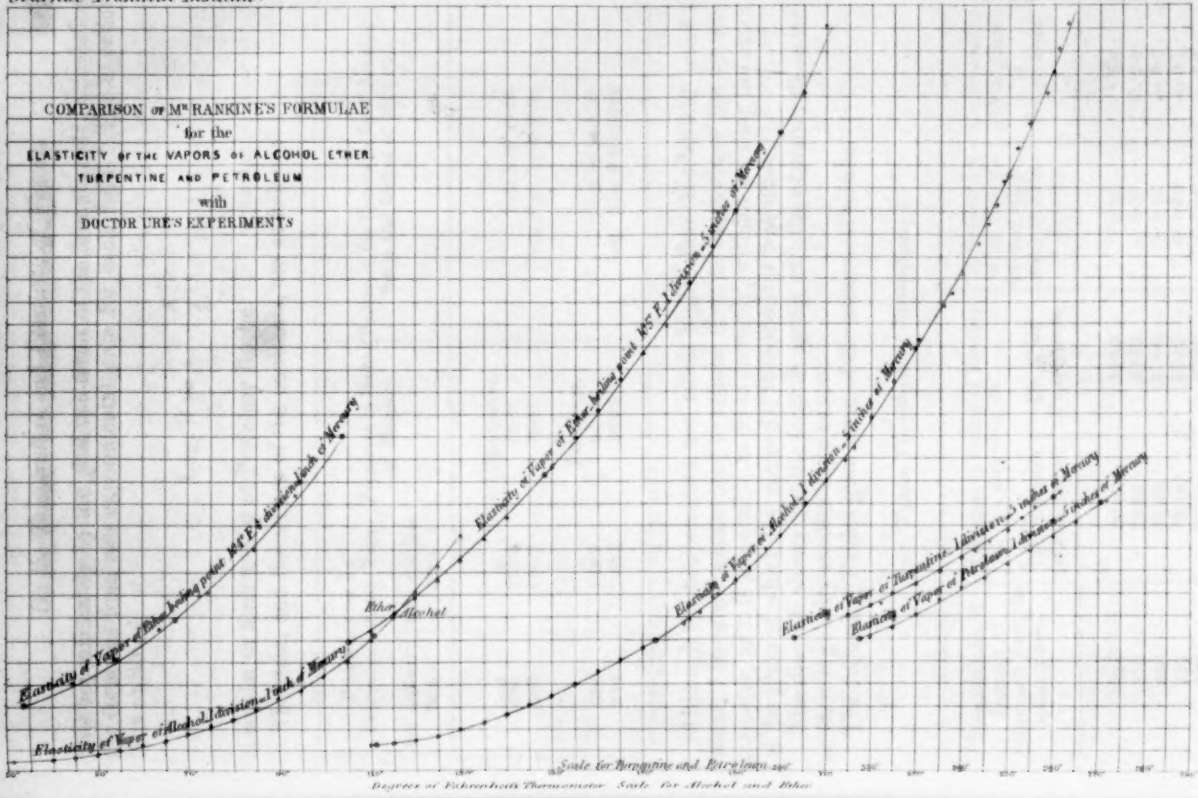
TABLE IV.—*Vapor of Ether—Boiling Point* 105° F.

Temperature in Degrees of Fahrenheit above the ordinary zero.	Pressures in Inches of Mercury according to		Differences between Calculation and Experiment in inches of Mercury.	Corresponding Differences of Temperature.
	The Formula.	Dr. Ure's Experiments.		
*105·0°	30·00	30·00	0·00	0·0°
110·0	33·08	32·54	+ 0·54	— 0·9
120·0	39·98	39·47	+ 0·51	— 0·7
125·0	43·83	43·24	+ 0·59	— 0·8
130·0	47·95	47·14	+ 0·81	— 1·0
140 0	57·10	56·90	+ 0·20	— 0·2
*148·8	66·24	66·24	0·00	0·0
150·0	67·53	67·60	— 0·07	+ 0·1
160·0	79·35	80·30	— 0·95	+ 0·9
170·0	92·68	92·80	— 0·12	+ 0·1
175·0	99·94	99·10	+ 0·84	— 0·6
180·0	107·62	108·30	— 0·68	+ 0·4
190·0	124·29	124·80	— 0·51	+ 0·3
*200·0	142·80	142·80	0·00	0·0
205·0	152·78	151·30	+ 1·48	— 0·7
210·0	163·27	166·00	— 2·73	+ 1·1
[1.]	[2.]	[3.]	[4.]	[5.]

TABLE V.—*Vapor of Ether—Boiling Point* 104° F.

Temperature in Degrees of Fahrenheit above the ordinary zero.	Pressures in Inches of Mercury according to		Differences between Calculation and Experiment in inches of Mercury.	Corresponding Differences of Temperature.
	The Formula.	Dr. Ure's Experiments.		
*34·0°	6·20	6·20	0·00	0·0°
44·0	8·02	8·10	— 0·08	+ 0·4
54·0	10 24	10·30	— 0·06	+ 0·2
64·0	12·94	13·00	— 0·06	+ 0·2
*66·7	13·76	13·76	0·00	0·0
74·0	16·19	16·10	+ 0·09	— 0·2
84·0	20·06	20·00	+ 0·06	— 0·1
94·0	24·64	24·70	— 0·06	+ 0·1
*104·0	30·00	30·00	0·00	0·0
[1.]	[2.]	[3.]	[4.]	[5.]

The results of Dr. Ure's experiments on the vapors of *turpentine* and *petroleum* are so irregular, (as the diagram shews,) and the range of temperatures and pressures through which they extend so limited, that the value of the constant γ cannot be determined from them with precision. I have, therefore, endeavored to represent the elasticities of those two va-


COMPARISON of Mr RANKINE'S FORMULAE
for the
ELASTICITY of the VAPORS of ALCOHOL ETHER
TURPENTINE AND PETROLEUM
with
DOCTOR URE'S EXPERIMENTS
Elasticity of Vapor of Ether boiling point M.S F.A. thirtieth Inch of Mercury
Elasticity of Vapor of Ether boiling point M.S F.A. thirtieth Inch of Mercury
Ether
Alcohol
Elasticity of Vapor of Alcohol Division Inch of Mercury
Elasticity of Vapor of Alcohol Division Inch of Mercury
Elasticity of Vapor of Turpentine Division 3 inches of Mercury
Elasticity of Vapor of Petroleum Division 3 inches of Mercury
Scale for Turpentine and Petroleum
Degrees of Fahrenheits Thermometer
Scale for Alcohol and Ether

pors approximately by the *first two terms* of the formula only, calculating the constants from two experimental data for each fluid. The equation thus obtained

$$\text{Log. } P = \alpha - \frac{\beta}{t}$$

is similar in form to that of Professor Roche.

The data, and the values of the constants, are as follows:—

Temperatures on Fahrenheit's Scale from the ordinary zero.	Temperatures on Fahrenheit's Scale from the absolute zero.	Pressures in Inches of Mercury.	Values of the Constants for Fahrenheit's Scale and Inches of Mercury.
		Turpentine.	
360°	822·3	60 80	$\alpha = 5{\cdot}9818700$
304	766·3	30·00	Log. $\beta = 3{\cdot}5380701$
		Petroleum.	
370	832·3	60·70	$\alpha = 6{\cdot}1945100$
316	778·3	30·00	Log. $\beta = 3{\cdot}5648490$

Although the temperatures are much higher than the boiling point of water, I have not endeavored to reduce them to the scale of the air thermometer, as it is impossible to do so correctly, without knowing the nature of the glass of which the mercurial thermometer was made.

The diagram shews that the formula agrees with the experiments as well as their regularity entitles us to expect.

The following Tables give some of the numerical results.

TABLE VI.—*Vapor of Turpentine.*

Temperatures in Degrees of Fahrenheit from the ordinary zero.	Pressures in Inches of Mercury according to		Differences between Calculation and Experiment in inches of Mercury.	Corresponding Differences of Temperature.
	The Formula (of two terms.)	Dr. Ure's Experiments.		
*304°	30·00	30·00	0·00	0·0°
310	32·52	33·50	— 0·98	+ 2·3
320	37·09	37·06	+ 0·03	— 0·0
330	42·16	42·10	+ 0·06	— 0·1
340	47·78	47·30	+ 0·48	— 0·9
350	53·98	53·80	+ 0·18	— 0·3
*360	60·80	60·80	0·00	0·0
362	62·24	62·40	— 0·16	+ 0·0
[1.]	[2.]	[3.]	[4.]	[5.]

TABLE VII.—*Vapor of Petroleum.*

Temperatures in Degrees of Fahrenheit, from the ordinary zero.	Pressures in Inches of Mercury according to		Differences between Calculation and Experiment in Inches of Mercury.	Corresponding Differences of Temperature.
	The Formula (of two terms.)	Dr. Ure's Experiments.		
*316°	30·00	30·00	0·00	0·0°
320	31·71	31·70	+ 0·01	— 0·0
330	36·35	36·40	— 0·05	+ 0·1
340	41·52	41·60	— 0·08	+ 0·2
350	47·27	46·86	+ 0·41	— 0·7
360	53·65	53·30	+ 0·35	— 0·5
*370	60·70	60·70	0·00	0·0
375	64·50	64·00	+ 0·50	— 0·7
[1.]	[2.]	[3.]	[4.]	[5.]

I have also endeavored, by means of the first two terms of the formula, to approximate to the elasticity of the vapor of *mercury* as given by the experiments of M. Regnault. The data and the constants are as follows:

Temperatures in Centigrade Degrees from		Pressures in Millimetres of Mercury.	Value of the Constants in the Formula $\text{Log. } P = \alpha - \frac{\beta}{t}$	
the freezing point.	the absolute zero.			
358·0°	632·6°	760·00	α for millimetres	= 7·5305000
			" for English inches	6·1259000
177·9	452·5	10·72	Log. β Centigrade scale,	3·4685511
			" Fahrenheit's scale, boiling point adjusted at 29·922 inches,	3·7238236

The following table exhibits the comparative results of observation and experiment.

TABLE VIII.—*Vapor of Mercury.*

Temperatures in Centigrade Degrees from the Freezing Point.	Pressures in Millimetres of Mercury according to		Differences between Calculation and Experiment in Millimetres.
	The Formula (of two terms.)	M. Regnault's Experiments.	
72·74°	0·115	0·183	— 0·068
100·11	0·480	0·407	+ 0·073
100·60	0·490	0·560	— 0·070
146·30	3·490	3·460	+ 0·030
*177·90	10·720	10·720	0·000
200 50	21·850	22·010	— 0·160
*358·00	760·000	760·000	0·000

The discrepancies are obviously of the order of errors of observation, and the formula may be considered correct for all temperatures below 200° C., and for a short range above that point. From its wanting the third term, however, it will probably be found to deviate slightly from the truth between 200° and 358°; while above the latter point it must not be relied on.

I have not carried the comparison below 72°, because in that part of the scale the whole pressure becomes of the order of errors of observation.

In conclusion, it appears to me that the following proposition, to which I have been led by the theoretical researches referred to at the commencement of this paper, is borne out by all the experiments I have quoted, especially by those of greatest accuracy, and may be safely and usefully applied to practice.

If the maximum elasticity of any vapor in contact with its liquid be ascertained for three points on the scale of the air thermometer, then the constants of an equation of the form

$$\text{Log. P} = a - \frac{\beta}{t} - \frac{\gamma}{t^2}$$

may be determined, which equation will give, for that vapor, with an accuracy limited only by the errors of observation, the relation between the temperature (t), measured from the absolute zero (274·6 centigrade degrees below the freezing point of water), and the maximum elasticity (P), *at all temperatures between those three points, and for a considerable range beyond them.*

Lecture on the Sciences as Applicable to Domestic Life, delivered at a meeting of the members and friends of the Retford Literary and Scientific Institution. By GEORGE CHAPMAN, ESQ.*

In these days of education and of the march of intellect, we commonly teach our children every art, every science, and every accomplishment that the mind of man can suggest; but we too often forget to teach them that which would turn all these to good effect, viz., to think, to reason, and to observe. "A mind which has once imbibed a taste for scientific inquiry," says Sir John Herschell, "and has learnt the habit of applying its principles readily to the cases which occur, has within itself an inexhaustible source of pure and exciting contemplations." One would think that Shakspeare had such a mind in view when he describes a contemplative man as finding

> "Tongues in trees, books in the running streams,
> Sermons in stones, and good in every thing."

Accustomed to trace the operations of general causes, and the exemplification of general laws, in circumstances when the uninformed and unenlightened eye perceives neither novelty nor beauty, he walks in the midst of wonders, every object which falls in his way elucidates some principle, affords some instruction, and impresses him with a sense of harmony and

* From the London Farmer's Magazine, for January, 1850.

order. Nor is it a mere passive pleasure which is thus communicated. A thousand subjects of inquiry are continually arising in his mind, which keep his faculties in constant exercise and his thoughts perpetually on the wing; so that lassitude is excluded from his life, and that craving after artificial excitement and dissipation of mind, which leads so many into frivolous, unworthy, and destructive pursuits, is altogether eradicated from his bosom.

Desiring at the same time to instruct the youthful and refresh the memory of the better informed portion of my hearers, I will not apologize for sometimes descending to what might otherwise be deemed examples too familiar to require explanation. Imagining myself, then, your companion from first awakening in the morning till the evening calls you again to repose, I will endeavor to explain the cause of the various phenomena that will fall under your notice.

We will therefore commence with the first object that presents itself to our view on awakening on a fine frosty morning. The window of our bed-room is probably covered with hoar frost, whilst that of the adjoining or dressing-room, though the aspect is quite as cold, remains perfectly clean. Now what is the cause of this phenomena? In the bed-room the vapor, arising from the breath of its inhabitants, has created a damp atmosphere, which, when it arrives at the window, becomes condensed upon the cold glass, in the same manner as we have observed on cold water jugs or other glasses when brought into a warm room. This condensed vapor, from the severity of the external atmosphere, is formed into ice in the most minute particles, and has caused those brilliant coruscations, in every variety of form and shape, which the process of crystallization has produced. The adjoining room having been destitute of an inhabitant, has had nothing to produce a damp atmosphere; and, therefore, though the temperature was the same, there is no appearance of frost on the windows. In frosty weather it is a common remark made to domestics to be careful in cleaning the windows, as the glass is brittle; and this certainly is the case, and for an obvious reason. The outside of the window is exposed to a cold frosty air, whilst the inside is warmed by the heated air of the room; hence, the two sides are expanded in different ratios, and a slight accident is sufficient to break the pane, just as hot water put suddenly into a cold glass may crack the vessel, especially if it be so thick that the heat is not readily transmitted through it.

Another curious circumstance may arrest attention on rising from bed, and that is the difference found on putting the feet upon a carpet or on a marble hearth; the cold of the first being scarcely perceptible, whilst the latter has a more chilling effect; and yet, if both were examined by the thermometer, they would be found of the same temperature. To explain this, it will be necessary to remember the fact, that bodies of different temperature, when brought into contact, assimilate the same heat—the one becoming colder as the other becomes warmer. Some substances are much quicker in imbibing and imparting warmth than others, and are therefore termed good or bad conductors of heat. In the instance just mentioned, the carpet is a bad conductor, consequently, when the warm foot is placed upon it, it does not suffer much loss of heat. On the contrary, marble is a very good conductor; the moment, therefore, the foot is placed upon it,

the marble absorbs a portion of the warmth, and having an easy mode of disposing of it, immediately calls upon the foot for a fresh supply. In the same way we account for the cold felt on immersing the hand in a basin of water, though the water is probably warmer than the air; but the superior conducting power of water renders us far more susceptible to the cold when conveyed by water than by air.

That color also exercises considerable influence in the absorption of caloric, may be shown by the following experiment:—When the ground is covered with snow, take four pieces of woolen cloth—black, blue, brown, and white—and lay them on the snow exposed to the sun; in a few hours the black cloth will have sunk considerably below the surface, the blue nearly as much, the brown considerably less, whilst the white will remain in precisely its former position on the surface of the snow. It thus appears that the sun's rays are absorbed by the dark colored, and excite such a degree of heat as to melt the snow beneath, but that they have little power to penetrate the white cloth. It is from this cause we observe that a white surface, such as the tombstones in a church-yard, will remain covered with hoar frost long after it has melted from the darker-colored foot-paths.

I will next draw attention to the pernicious practice of sleeping with the curtains drawn close around our beds, which would scarcely be persisted in did we but reflect on the effect produced by thus depriving ourselves of pure air during the hours of sleep. Air that has been once breathed is rendered unfit for animal life until it has again been purified; it is composed of two gases, termed oxygen and hydrogen: the first of these is the great agent in respiration and combustion; the latter is of a contrary nature, and is fatal to animal life. Yet on the proper mixture of these two gases the purity of our atmosphere depends. In the process of respiration the air is deprived of a large portion of its oxygen, and obtains in its stead a portion of carbonic acid gas, which also, like hydrogen, is not capable of supporting life. It therefore now follows that air, after it has served the purposes of respiration, is no longer fit for man till it has been purified in nature's best laboratory, where that portion which was unfit for animal life is absorbed by the vegetable world, and the other substances by which it is brought into contact, and from them it again absorbs its proper proportion of oxygen gas. The air, as it passes through the lungs, is brought into very close contact with the blood as it returns from its circuit round the system: it is then in a dark colored state, and unfit to be again circulated. From this close connexion with the atmospheric air, it speedily obtains a large supply of oxygen, which turns it to a beautiful bright red, and it is again fit to be expelled by the action of the heart to the extremities; the blood by this means has become pure, but the breath at the same time has become vitiated, being deprived of its vital quality, and having imbibed carbonic acid in its stead. It therefore follows, that the more we are exposed to the free air of heaven the better will be the state of our blood. Of the pure air, a man requires about a gallon per minute; so that if the curtains of a bed are closely drawn, we may easily imagine how prejudicial such an atmosphere must be. There is positively less risk of infection in attending the fever wards of an hospital, where the beds are without testers or drapery of any kind, than in the more luxurious bed-rooms of the middle and higher classes of society, where frequently the excess of

anxiety and fear that a too cold air should visit the patient induces the tender nurse to draw close the curtains, and thus exclude the first of medicines—a pure atmosphere.

[Mr. Chapman here quoted a passage from "Waterton's Essays on Natural History," showing the folly of excluding night-air from our dwellings, and proceeded:]

In performing our morning ablutions, we shall be led to remark the difference between hard and soft water, and their different action upon soap. Hard or spring water has, by filtering through the earth for a considerable time, imbibed many impurities from the various earthy and mineral substances with which it has come in contact. "There is a very curious fact," says Professor Griffiths, "presented during the formation of lime-water, namely, that the colder the water the more lime will it actually dissolve: thus, water at 33°, or near the freezing point, will dissolve exactly twice as much lime as water will do at 212°, or its ordinary boiling point."

These impurities have the effect of decomposing the soap, and preventing its solution by the water, on which the washing properties of the soap depend. Rain water, before coming in contact with these soluble substances, is pure—being, in fact, condensed vapor or steam. White soap dissolved in strong spirits of wine, so as to form a clear transparent liquid, is a simple and accurate test of the relative purity of water. Soap is perfectly soluble in pure or distilled water,—hence no curdling ensues when added to it; on the other hand, if the water contains sulphate of lime, (upon which its hardness generally depends,) the soap is immediately decomposed: it is a compound of soda and fatty or oily matter, and the lime combines with such matter, forming an insoluble soap, or curd.

Whilst speaking of the properties of hard and soft water in dissolving soap, we are forcibly reminded of our early days, and the hours we have spent in blowing soap bubbles, watching the beautiful colors they assume, till, just as they appear to have attained the height of perfection, they suddenly vanish, and disappoint all our hopes; like many an airy day dream which, since that time, has filled our imagination, and has as suddenly disappeared. A bubble is nothing more than a very thin film distended with air. When blown from a tobacco-pipe we see it ascend, the warm breath with which it is filled being lighter than the external cold air, the difference being more than the weight of the light film forming the bubble; in a very few seconds, however, if they do not previously burst, these miniature balloons fall, the air contained in them condensing as they cool, when the weight of the film brings them to the ground. This, however, is but a small portion of the wonders of the soap bubble, which will be heightened in our estimation when we find that, in his observations upon it, the great Newton was assisted in some of the most astonishing discoveries in optics that have ever been made. The changing colors of the soap bubble caught his attention, but how to account for it was the difficulty which he has solved in his theory of light. It is, however, far too deep a subject for present consideration. I will, therefore, merely explain that white light, as we may term it, consists of three primary colors, red, blue, and yellow, but which, when blended together, make white. That the mixture of red, blue, and yellow produces white, may easily be shown by dividing a circular card into three equal parts, coming to a point in the centre, and

painting the one part blue, the next red, and the next yellow; if a pin be put through the centre, and the card rapidly turned round on it, it will appear white. Now light, on passing through a medium, such as glass or water, under certain circumstances, becomes refracted or bent; and, according to the different degrees to which the ray is bent, it assumes different colors on emerging, by refraction, from the medium through which it has passed. The various colors of the soap bubble, therefore, depend on the slackness of the film through which the ray passes, because different thicknesses will give a different angle of refraction or bending, and a bubble is constantly growing thinner till it bursts. Thus the various hues it presents are accounted for.

Having entered the breakfast-room, let us examine the phenomena which present themselves most worthy of observation. The first striking object will be the kettle boiling, and steam rising from the spout. Here we have a familiar illustration of the process of evaporation, which, when carried on by nature in her vast laboratory, is the cause of rain and fair weather, the sunshine and the storm. In the instance before us, the fire is acting the part of the sun; and on the principle already mentioned, when two bodies of different temperatures come in contact, (the one imparts and the other imbibes,) the fire imparts a portion of its heat to the water, which rises in temperature till it arrives at the boiling point, when it changes its character, and, from an almost incompressible fluid, becomes that highly elastic vapor, steam, whose giant arm is so wonderfully employed in chasing the face of the universe, and connecting the remotest corners of the globe by its expansive power. But perhaps it will be requisite, before proceeding further, to say a few words on heat, or caloric, as it is more scientifically termed. Caloric, then, may be familiarly defined as an extremely subtle quality residing in every substance; and although it cannot be termed material, it has the property of insinuating itself between the pores of substances, and causing them to repel one another and fly asunder, increase of temperature being almost invariably attended with increase of bulk.

In the instance of the kettle, the water has absorbed caloric from the fire, which, mingling with its particles, has caused them to repel one another, till they have overcome the density of the fluid, and it flies off in the shape of steam. This vapor diffuses itself over the room till it meets with some cold surface, which condenses it into its original state of water. In a room where there is a large party, and, consequently, a considerable quantity of water, so that, from the warmth of the room, it may be invisible, we shall observe, on cold glasses being introduced, that they are immediately covered with steam. It is from a circumstance exactly resembling this that southerly winds are often accompanied with rain. The regions over which a southerly wind has passed, in coming to us, are generally warmer than the part we inhabit; the wind, therefore, is warmer. Now we know that warm air will retain a larger portion of vapor than cold air will, because, when the cold tumbler was brought into the room, the water contained in solution in the air was immediately deposited on the glass; in like manner, the warm south wind, when it arrives in our colder climate, is obliged to abandon a portion of the vapor it held in solution, which consequently falls in the shape of rain.

It, at first, appears extraordinary that steam, which is, as we have just

seen, only water in a different form, should be so light as to rise in air; yet such is the case, the repulsive power of heat having separated the particles to such an extent that it has become even lighter than air: that is to say, a pound of water converted into steam occupies more space than a pound of air would do; it is, therefore, specifically lighter, and floats in the air, till the coldness of the atmosphere into which it ascends, by robbing it of its caloric, reduces it to a dense fluid, when it descends in air almost imperceptible, as dew or rain.

The current of air and smoke which ascends the chimney is again an object to attract our attention, caused by the same expansive power of heat. The air, as it passes through and over the fire, becomes greatly increased in bulk, and consequently lighter, causing it to ascend through the denser part, leaving its space to be filled by cold air from the door or window. By this means the fire is supplied with the proportion necessary for combustion, whilst a considerable quantity of rarified air ascends the chimney, carrying up with it the smoke or dense vapor which arises from burning bodies. It may be inquired how it is, when a fire is lighted in a room, the air does not descend the chimney to supply it, because that appears the easiest access to the outside air; and this, if the chimney were very large, and quite open above, so as to admit space enough for an ascending and descending current, might be the case. To obviate this, we contract the opening at top by putting on a chimney pot, by which means the current of ascending air is rendered so strong through the small aperture as to prevent the external air from entering.

Sudden gusts of wind are apt to cause chimnies to smoke, by removing the equality of the atmospheric pressure on the outside. During the gust the perpendicular pressure is partly removed by the velocity with which it passes over; the consequence is that, during the time of the gust, whilst the pressure is removed, there is a rapid draft up the chimney, caused by the want of resistance above; but the moment the wind lulls again, this pressure returns, the upward draft is suddenly checked, which causes a momentary obstacle to the ascending current, and a puff of smoke in the room is the probable result. Some particular direction of wind will generally influence a chimney in this way more than another, either from some peculiarity in the situation above, or from the apartment being more or less immediately influenced by the same cause; for it is clear, if the variation of pressure above and in the room is simultaneous no confusion will take place; but if one happens a few seconds after the other a contrary effect will be produced.

In warm weather we often find a disagreeable smell of soot in our rooms, the reason of which is that, in the day time, whilst the outward air is very warm, the chimney, not having been in use, and being removed from the sun, is considerably colder; it consequently cools the air and condenses it, causing it to descend into the room. In the night, when the air in the room is warmer than the external air, it expands and rises in the chimney.

It is this same principle which influences the land and sea breezes of tropical climates; the surface of the shore becoming very much heated by the perpendicular rays of the sun, the air above it is warmed, causing it to ascend, and the space left is filled by fresh air from the sea; for the sun's rays having penetrated deeper into the water, the surface has not become

so hot, and the air above is comparatively cool. In the night, when the surface of the earth becomes cool, the air above it condenses and descends, whilst the air above the water has become the warmest, because the water is giving out the heat which it had imbibed during the day; the wind will therefore blow from the land to the sea.

By taking a glance over the breakfast table, we shall be reminded that a bright silver tea pot will make better tea than an earthenware one, and for this simple reason—that bright surfaces radiate or throw off heat much slower than black or dull ones, consequently the tea is kept better. From this we may learn, that whenever heat is to be retained a bright vessel should be employed; but, on the contrary, if we want a vessel to absorb heat rapidly, a black surface is the best. The quickest boiling saucepan, therefore, will be the one which is black on that part exposed to the fire, but bright on the portion which comes only in contact with the air; the black part acting as a good conductor, to allow the heat to approach the water—the bright as a bad radiator to prevent its escape. Woolen, as before stated, in the instance of the carpet, is a bad conductor, therefore a very proper substance to wrap round anything which is to be kept hot; and, by the same reasoning, although it may sound rather contradictory, it will equally keep any substance cold; for instance, a piece of ice wrapped in woolen will be much slower melting than another piece not so enveloped. Heat and cold, we must remember, are only relative terms, as there is no precise point where heat ends and cold begins.

Before leaving the breakfast room, we will just observe the effect of a lump of sugar put into a cup of tea; we shall find it will be some time melting if left at the bottom of the cup, but if we hold it in a spoon at the surface it will dissolve very speedily. This arises from the sugar, as it melts, rendering the tea heavier; the sweetened portion therefore descends, leaving the sugar constantly in contact with a fresh portion of unsweetened tea, keeping up a continual circulation till it is all dissolved; whereas, when the sugar is at the bottom of the cup, it remains in the sweet portion of the liquid, which, becoming saturated, causes it to dissolve the sugar, and it requires stirring to bring it in contact with the unsweetened portion of the tea. This may be prettily shown if we color a lump of sugar with a little ink, and put it at the bottom of a deep glass, gently filling it with water, then color another lump, and hold it at the surface of another similar glass; the one will be dissolved away quickly, while the other will remain at the bottom of the glass.

To be continued.

On the Production of Lightning by Rain. By William Radcliff Birt.*

On the 26th of July, 1849, a severe thunder-storm, accompanied by the destruction of property and the loss of human life, passed over the metropolis. About 1h. 30m. P. M., the clouds towards the north-east presented a very dark and threatening aspect; they assumed an inky color, and the velocity of their motion was very slow; in fact, the appearance noticed was strikingly of that character which the writer has frequently

* From the London, Edinburgh, and Dublin Philosophical Magazine, for September, 1849.

observed to precede a thunder-storm. On this occasion his attention was more particularly directed to the connexion between the electric discharge and the sudden gush of rain that more or less accompanies it, with a view to illustrate the question occurring in the Report of the Committee of Physics, approved by the President and Council of the Royal Society, p. 46, "Is this rain a *cause* or *consequence* of the electric discharge?" *

On the previous day, the 25th, about 3h. 50m. P. M., during a thunder-storm a sudden gush of heavy rain occurred, which, within two seconds, by estimation, was *succeeded* by a vivid flash of lightning: the thunder occurred at a further interval of some few seconds. From this it would appear, provided the heavy rain fell over the entire space between the place of observation and that of the electric discharge, that it was not a *consequence* of that discharge, the gush occurring at a sensible interval previous thereto.

The setting in of the storm of the 26th, about 1h. 45m. P. M., again called the attention of the writer to this point; and several flashes occurred between 1h. 45m. P. M. and 2h. 3m. P. M., without being preceded by a gush, although heavy rain more or less accompanied the discharges, in one or two instances almost simultaneously or immediately afterwards. At length, about 2h. 4m. P. M., a most violent and very remarkable gush of rain occurred, which was followed within one minute by a most vivid flash of lightning, the thunder succeeding almost instantaneously. The windows of the house in which the writer was observing the storm were sensibly shaken, and portions of the mortar between the arches over the windows and the frames thrust out, of course by concussion. Within a minute or two after this discharge a partial cessation of the heavy rain took place, but sudden gushes occurred at short intervals within the next six or seven minutes; they were, however, unaccompanied by lightning.

At the end of this period the atmosphere presented a very remarkable appearance; a perfect stillness characterized the air, which possessed great transparency, so that the surrounding objects were seen with very minute distinctness of detail. The stillness and transparency during the time they continued, riveted the observer to their contemplation. It appeared that during this time the storm was hushed, and a calm of a rather extraordinary character succeeded it, during which a rather large break in the clouds was seen towards the south-east, and the entire phenomena at this time induced the idea that the weather was clearing up. Within ten minutes, however, the storm again burst forth; the lightnings played, the thunder roared, and heavy rain, mingled with hail so thickly that comparatively near objects could scarcely be distinguished, fell in torrents, and the writer

* The paragraph runs thus:—"There is one point to which we wish that some attention might be paid,—it is the sudden gush of rain which is almost sure to succeed a violent detonation immediately overhead. Is this rain a *cause* or *consequence* of the electric discharge? Opinion would seem to lean to the latter side, or rather, we are not aware that the former has been maintained or even suggested. Yet it is very defensible. In the sudden agglomeration of many minute and feebly electrified globules into one rain-drop, the quantity of electricity is increased in a greater proportion than the surface over which (according to the laws of electric distribution) it is spread. Its tension, therefore, is increased, and may attain the point when it is capable of separating from the *drop* to seek the surface of the *cloud*, or of the newly-formed descending body of rain, which, under such circumstances, and with respect to electricity of such a tension, may be regarded as a conducting medium. Arrived at this surface, the tension, for the same reason, becomes enormous, and a flash escapes."

observed, during the remainder of the storm, four or five sudden gushes that were quickly *succeeded* by lightning.

On all these occasions, he is quite certain that the sudden gush of rain *preceded* the electric discharge. Of all the discharges, which were very frequent, that at or near 2h. 5m. P. M. appeared to the writer to be *nearest* his own locality; the lightning appeared to him to be quite as, if not more, vivid than that at any other discharge; and the interval between it and the thunder was certainly the shortest, the thunder being the loudest.

Between 2h. 0m. P. M. and 2h. 15m. P. M., according to the concurrent testimony of several witnesses, and preceding the precipitation of the hail nearly half an hour, a discharge struck half-a-dozen houses, being Nos. 17 to 22 in West street, North street, Whitechapel, between one-fourth and one-third of a mile south of the writer's residence. The stroke appears to have presented some phenomena of an interesting and remarkable character.

Immediately behind and to the west of the houses in question is situated a large open space of ground, known as a Jews' burying-ground, in which is a piece of water not far from the houses. The gable end of No. 22 faces the west, the fronts of the houses the north, and their backs the south; the flues of No. 22 form part of the wall at the gable end. At the front and between every alternate house is a metallic spout, for the purpose of carrying off the water from the roof; the water is received from the tiles in a leaden or zinc gutter, which is in metallic communication with the spout; but it does not appear that there is a metallic communication between the gutters from house to house: these metallic spouts are short, not in any case descending so low as the doors; they are replaced by wooden spouts, which convey the water to the street.

It appears that the stroke perforated one of the chimney-pots of No. 22, descending the flue to the roof, which is stripped of a great portion of the tiles,* and then passed to the metallic spout in front, disrupting and tearing away the lower wooden spout, a piece of which, seven feet in length, it rent off and hurled with great violence into the back yard of one of the opposite houses which abutted on the north side of West street; a great portion of the piece rent from the spout, was shivered into small splinters about two inches long. A portion of the stream appears to have been conducted by the gutter communicating with the metallic spout of No. 22 to that between Nos. 20 and 21, down which it proceeded, thrusting the lower wooden spout about three or four inches from the wall, and chipping away portions of the brickwork in its passage through the front wall of No. 21, which it perforated, (the aperture being of a considerable size,) and immediately passed to the principal wheel of a silk-winding machine. A woman who was attending the machine, and had in her hand at the moment a spindle, received a severe shock, and was hurled by the force across the room.

This stream appears to have given off a lateral stroke, which manifested its effects at the box of the lock of the street door, tearing away the plastering and paper as it passed into the front room, in which a pane of glass was shattered. A woman who was near this room at the time, described

* The western wall of this house has been so shaken by the stroke, that it is considered necessary that it should be taken down and rebuilt.

the passage as being filled with a light of a blue color, and saw the lightning pass out of the back window over her child's head.

It would appear that, at the time the lightning was passing from one metallic conductor to another, in the immediate front of the houses, a young man, named Thomas Johnson, opened the street door of No. 17; he was accompanied by a lad of about 14 years of age, who was, almost immediately after the door was opened, thrown backwards. The shock was so sudden that he knew not what happened to Johnson, who was found shortly after lying on his side, his back to the wall and his feet just beyond the threshold of the door quite dead. He was evidently struck by the lightning, which, playing in the front of the houses, was probably attracted by the metallic spout that terminated a few feet above the door. The plaster just above the door, and which was most probably over his head, was torn away, but there is no mark or perforation to trace its entrance from above; the probability appears to be, that a stream struck upwards immediately after striking him. The two houses immediately opposite to Nos. 21 and 22 also received some injury from the lightning glancing sideways, as it were, from the principal stream which shattered the roof of No. 22.

It cannot fail to be remarked that the principal mischief, after No. 22 was struck, occurred in the front, and more or less in the neighborhood of the metallic spouts, which answered the purpose of *imperfect* conductors, the metallic continuity being *interrupted* on the roofs by the leaden gutters extending only a certain distance on each side of the metallic spouts, and also in front of the houses by the wooden spouts carrying the water to the earth. In connexion with the presence of the lightning in the front, the altitude of the houses struck renders it rather improbable that the stroke descended *immediately* from the cloud. The houses in West street are the *lowest* in the neighborhood; those in the street immediately to the north are rather higher; and at the further end of the street, near No. 1, are three houses in North street considerably *higher;* so that, had the stroke descended immediately from the cloud above, which it is to be presumed was at the usual elevation of clouds under these circumstances, the probability is, that the *high* houses in North street would have been struck rather than the *low* houses at the further end of West street. Should it have been the case that the stroke emanated from an altitude but little above the houses struck, we have evidently to seek the cause of the discharge *below the cloud.*

It is extremely difficult to connect the stroke with the discharge at 2h. 5m. P. M., although the concurrent testimony of the witnesses would lead to the high probability that such was the case, especially as one stated that it occurred some considerable time previous to the hail that fell. The general impression in the neighborhood appears to have been, that the lightning shot or glanced over the houses to the north of West street, when it struck the corner, and did not descend perpendicularly from a considerable height. The discharge at 2h. 5m. P. M. was, as we have already observed, *preceded* by a gush of heavy rain; and taking the suggestion in the report alluded to above into consideration, there appears to be great probability that the formation of the lightning was in accordance therewith. For upwards of half an hour violent meteorological action had taken place, the precipitation of rain being very prominent. There can be no question

that this precipitation was accompanied by well-marked electrical phenomena; and when, as at 2h. 5m. P. M., an increased and sudden precipitation occurred, it is likely that an agglomeration of the smaller drops took place, increasing, as suggested, the electric tension to such an enormous extent, that a flash escaped *in the immediate neighborhood of the houses struck;* and when we consider that, at the time, several millions of drops must have been falling, each contributing its quota to the general result, it is not to be wondered at that the tension of the electricity was so great as to produce the very violent effects witnessed.

Bethnal Green, August 4, 1849.

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*Rain the Cause of Lightning.**

GENTLEMEN:—As the whole science of meteorology depends upon the number of phenomena observed, I am led to trouble you with the following short notice of a phenomenon which particularly engaged my attention during its occurrence; if you deem the communication worthy to be inserted in your Journal, you will oblige T. H. DIXON.

Leeds, October 17, 1849.

I observed a paper upon this subject in the Philosophical Magazine for September last, and it reminded me that I had observed a similar phenomenon, of which I made some notes at the time of its occurrence.

On the evening of June 4, 1849, a very severe thunder-storm visited Leeds and the neighborhood. My attention was particularly directed to this storm from a peculiar circumstance connected with it; the storm begun about 9 P. M., and continued until 12, but the rain did not begin till 11. The whole of the shower which followed was characterized by the wave-like intensity of the falling rain; first the shower began very violently, and gradually got less intense, until succeeded by another sudden increase, and during the whole storm this increase and decrease could be distinctly marked. I also noticed a similar circumstance at Redcar in July, and can most certainly bear witness that, in many instances, the increase of rain preceded the flash of lightning, and this occurred many times in succession. If, from observation, we find the rain during thunder-storms has this peculiar characteristic, we may safely consider that rain has something to do with the production of electricity, but as yet our observations are so limited, that it would be unsafe to form any theory; but we may hope the phenomenon will be observed by others, and also that they will make their conclusions known, and ultimately we may be led to a new meteorological fact.

On the Means of Preventing the Corrosion of Steam Boilers.†

The writer proposes to effect the prevention of the corrosive action exerted by the water on the interior of boilers, by applying over the whole of the inside a thin coat of varnish, of such a nature that, while it would remain unaffected by the high temperature to which it would be exposed,

* From the London, Edinburgh, and Dublin Philosophical Magazine, for November, 1849.

† From the London Artizan, for December, 1849.

it should offer no serious resistance to the regular transmission of heat from the iron to the water. To effect this object, he proposes to pour a small quantity of coal tar into the water, immediately before the steam is about to be got up. This substance possesses the singular property, when thrown into boiling water, of parting with its volatile portions, and diffusing the remainder of its substance, as a hard insoluble pitch, all over the interior of the vessel, effectually preventing a sufficiently close contact between the water and sides to allow of chemical action, while it is so superficial as not to impair the efficiency of the boiler, by lessening the conducting power of its surface.

On the Present State of Electro-Telegraphic Communication in England, Prussia, and America. *By* MR. WHISHAW.*

Mr. Whishaw stated that the object of his present communication was not to bring before the Section the numerous telegraphic instruments now in use and recently made public; but to point out the advantages and disadvantages of the three great systems of electric telegraphs now in operation in England, Prussia, and America. In England the wires, being suspended from post to post along the sides of railways, are exposed to the following disadvantages—running of trains off the lines, by which the posts and wires are all carried away together, and thus the communication is stopped. Secondly, from atmospheric influences, whereby irregular and uncertain deflexions of the needles in Cooke and Wheatstone's telegraphic instruments take place, besides occasional declination to parts of the instruments, &c. Thirdly, from snow storms, as in the case of the South-Eastern telegraph which occurred during the last winter, when the wires and posts were all removed, and considerable interruption was caused in the transmission of communications. Fourthly, from damage by malicious persons, who sometimes twist the wires together, and for whose apprehension rewards have frequently been offered by the English companies. Fifthly, the wires have sometimes been connected together by a fine wire nicely soldered to the line wires, and thus the communications have been diverted from their right channel. Sixthly, the expense, viz., £150 a mile, for the above-ground system, with an annual expenditure for repairs. Seventhly, and consequently, heavy charges for the transmission of messages. Eighthly, the time required in learning perfectly the manipulations of the needle telegraph, so that if a telegraphist is from any cause disabled, there is no one at hand to take his place.

With regard to the charges, the following facts will suffice to show the advantages of economical telegraphs. In America, the charge for twenty words transmitted by the telegraph to the distance of 500 miles is but 4*s*.; whereas, by the English company's charges, the same communication would only be transmitted 60 miles, or less than one-eighth the distance, and by the South-Eastern Company's charges, not 20 miles, or one twenty-fifth of the 500 miles. Again, a communication of ninety words, in America, may be transmitted from Washington to New Orleans, 1716 miles, for 41*s*. 8*d*.; whereas, by the Electric Telegraph Company's charges, it

* From the London Athenæum, for September, 1849.

would only be transmitted a little more than 200 miles,—and by the South-Eastern Company's scale, under 100 miles.

The extent of telegraphs in Great Britain at present is about 2000 miles; and there yet remain railways to an equal extent without telegraphs. Mr. Whishaw expressed a hope that within a short time every principal town in the kingdom would be connected by telegraph, as the under-ground system may be effected without the aid of railways, viz., under turnpike roads and towing paths, &c. This plan has been practically carried out in Prussia, where, at the present time, there are 319 German miles= 1492·92 English miles in actual operation. A single wire, coated with gutta percha, is laid under the railway at a depth of two feet, and connected with the instruments and batteries at the different stations. A colloquial and also a printing telegraph are used in each principal station—both worked, as required, by the single wire.

The experiment as to burying the gutta percha wire in the ground was commenced some years ago, and being found to answer perfectly, the Prussian Telegraph Commissioner appointed in 1844 determined on adopting the underground plan entirely for the government telegraphs, and which were commenced in July, 1848, so that no time has been lost in carrying them out. At Oderbay, the Prussian system is, in connexion with the telegraphic line now in course of construction between that place and Trieste viâ Vienna, and, as regards the Prussian Government Telegraphs, the public has the advantage of them by payment of certain fixed rates. The cost of the Prussian system is under £40 a mile.

The American system is remarkable for the great extent to which it is already carried, viz., 10,511 miles, costing less than £20 a mile. It consists of a single iron wire supported from post to post, but is carried far beyond the limits of railways, and is consequently frequently damaged, so that a code of rules is established for the repair of the wires, which is undertaken by gentlemen living along the lines, and who are furnished with a set of tools for the purpose—their reward being the free use of the telegraphs for their own private communications. The economy of first cost, however, causes a very low tariff for the transmission of communications, so that the poorest person is enabled, for a few cents, to send a communication to a considerable distance. From the actual operations of the three systems, it appears that the Prussian is the most simple, effective, and economical—for annual repairs are not required to the line wires, as in the cases of England and America, where they are exposed to so many casualties.—*Proc. Brit. Assoc.*

On the Friction of Water. By R. Rawson, Esq.*

The object of this paper was to ascertain the friction of water on a vessel or other floating bodies, rolling in water. For this purpose experiments have been made upon a cylindrical model, whose length is 30 inches, diameter 26 inches, and weight 255·43 lbs. avoirdupois, in the following manner: The cylinder was placed in a cistern, in the first place, without water, and made to vibrate on knife-edges passing through the axis of the

* From the London Mechanics' Magazine, for September, 1849.

cylinder. A pencil projecting from the model in the direction of the axis of the cylinder, on the surface of another movable cylinder, marked out upon paper placed upon this last cylinder the amplitude of each oscillation. The cylinder was deflected over to various angles, by means of a weight attached by a string to the arm of a lever fixed to the cylindrical model:

Angle of Deflexion.	Angle to which the Model vibrated.
22° 30′	22° 24′
22 10	22 6
21 54	21 48
21 36	21 30
&c.	&c.

When the cylinder oscillated, in all circumstances the same as above, except being surrounded by salt water, the amplitude of oscillations were as follows:

Angle of Deflexion.	Angle to which the Model vibrated.
22° 30′	22° 0′
21 36	21 3
20 48	20 16
&c.	&c.

Clearly showing that amplitude of vibration, when oscillating in water, is considerably less than when oscillating without water. In the above instance there is a falling off in the angle of amplitude of 24′, or nearly half of a degree. This amount has been confirmed by several experiments made with great care; and it appears only fair to attribute this decrease in the amplitude of oscillation to the circumstance of the friction of the water on the surface of the cylinder. The amount of force acting on the surface of the cylinder, necessary to cause the decrease in the amplitude of oscillation shown by the experiment was calculated; and the author thinks that this amount of force is not equally distributed on the surface of the cylinder. In consequence of this, he thought the amount on any particular part might vary as the depth. On this supposition, a constant pressure at a unit of depth is assumed. This, multiplied by the depth of any other point of the cylinder immersed in the water, will give the pressure at that point. These forces or moments being summed by integration and equated with the sum of the moments given by the experiments, we shall have the following value of the constant pressure at a unit of depth: ·0000469. The constant of another experiment, (the weight of the model being 197 lbs. avoirdupois, and consequently the part immersed in the water was very different from the other experiment,) was ·0000452, which differs very little from the former, showing that the hypothesis assumed in the computation is not far from the truth.—*Proc. Brit Assoc.*

For the Journal of the Franklin Institute.

Launch of the U. S. Steamship "Powhattan."

This splendid steamer was launched from the Gosport Navy Yard, Norfolk, on Thursday, Feb. 14, 1850. The following are her dimensions:—Length of keel, 246 feet; between perpendiculars, 250 feet; extreme length from billet to taffrail, 276 feet 6 inches; on deck, 251 feet 6 inches; breadth of beam, 45 feet; over guards, 69 feet 6 inches. She is to have side

wheels, be propelled by two inclined engines, with cylinders 70 inches diameter and 10 feet stroke, and will have four copper boilers. Her machinery is in course of construction by A. Mahaffy & Co., whose establishment is adjoining the Navy Yard, and the ship is expected to be ready for trial during the year. W.

On the Strength of Materials. By GEORGE BUCHANAN, ESQ., F. R. S. E.*

In this exposition, Mr. Buchanan, after apologising for the length to which he had been imperceptibly drawn in these communications, commenced by recapitulating the general principles which had formerly been laid down regarding the tensile and compressive strains of materials, and, in addition to the results of former experiments, made at the request of the Society, on the stones from different quarries in the neighborhood, gave now the results of others, which had since been carefully made on the harder materials of Caithness and Arbroath pavement, along with white marble and whinstone, as follows, viz:—

	Tensile.	Compressive.
Whinstone,	1469 lbs.	8270 lbs.
Arbroath pavement,	1261	7884
Caithness do.	1054	6493
Marble,	722	6431

In all these experiments the peculiar nature of the two strains is distinctly exhibited; the specimens exposed to the tensile strain showing a clean fracture and no fragments; those exposed to the compressive being generally crushed to powder, and the fragments flying in all directions by lateral divergence; and generally, when any considerable fragment remains, showing the appearance of a pyramid from which the sides of the square had been broken—a form which has also been observed in the compression of cast iron.

In regard to the transverse strength, he repeated the principles and general rule for calculation formerly explained, by adopting what he termed a unit of strength, which differs in each material, but, being once determined by actual experiment, affords a *datum* for calculating the strength of that material in every case, whatever be the dimensions of the masses acted on. This unit expresses the strength of a cubic inch of the material—*i. e.* a bar 1 inch square, supported on bearings 1 inch apart, and loaded in the middle till it breaks. The strength of such a unit for cast iron had been given on a former evening at 11 tons. In regard to timber, he had himself made various experiments on Memel fir, and had found the unit 4000 lbs. Oak and beech, by other experiments, was found 6000 lbs.; ash, 8000 lbs.

In regard to the transverse strength of stones, few experiments, he said, had been made on our building materials, although it was a strain they were much subjected to in stairs, balconies, covers of conduits, &c. He proposed, therefore, to try several specimens which were now before the meeting—viz., Hailes pavement, Craigleith, and Arbroath. Each of these specimens was 3 inches thick, 9 inches broad, laid flatways and supported at each end between two upright pillars, the distance between the bearings

* From the London Civil Engineer and Architect's Journal, for December, 1849.

being exactly 3 feet. These specimens were loaded by weights successively laid on a scale hung from the centre of the pavement, until it broke. The Hailes was first tried, and, after carrying successively 4 cwt. and 5 cwt. for a little time, at last it gave way with 7 cwt. 10 lb. A specimen of the same rock and dimensions, previously tried, gave nearly the same result, being 7¼ cwt. The Craigleith carried considerably more. After bearing 7 cwt. and 8 cwt. for some time, it gave way at last with 10½ cwt. The Arbroath pavement was found still greatly ahead even of the Craigleith. After carrying 12 cwt. and 14 cwt. for some time, it went on bearing 16½ cwt. This it bore for a short interval; and while an additional weight was in the act of being put on it gave way. These experiments are important, and appeared to excite much interest. From these the unit of strength is easily calculated.—*Proc. Roy. Scot. Soc. Arts.*

On a New Thermometric Scale. By Mr. S. M. Drach.*

Having lately had occasion to advert to the superior practical utility of Fahrenheit's thermometric scale, as not ordinarily requiring decimal divisions and negative degrees like its congeners, it occurred to me that a superior scale was feasible by dividing the distance from —40° Fahr. = —40° Cent. = —32° Reaum., unto the boiling point +212° Fahr. = +100° Cent. = +80° Reaum., into one thousand degrees, placing zero at the former temperature. Thus one of my degrees = 0°·252 Fahr. = 0°·140 Cent. = 0°·112 Reaum.; and, except for some chemical purposes and extraordinary arctic temperatures, *no negative degrees would be necessary.*

If the zero were placed at

$$-38^\circ \text{ Fahr.} = -38^\circ{\cdot}8 \text{ Cent.} = -31^\circ 1 \text{ Ream.},$$

$$\text{my degree} = \frac{1}{4} \text{ Fahr.} = \frac{10}{72} \text{ Cent.} = \frac{1}{9} \text{ Reaum.}$$

easier for marking off the point of melting ice in whole degrees. Some of the prominent points in these two scales are as follows:

Mercury freezes	—	39° F.	= +	4·0 (1)	or —	4° (2)
Fahrenheit's zero	+	0	=	158·7	= +	152
Ice melts	+	32	=	285·7	=	280
Water's max. density	+	39	=	313·5	=	308
Medium temp. 10° C.	+	50	=	357·1	=	352
Equatorial temp.	+	84	=	492·1	=	488
Blood heat	+	98	=	547·6	=	544
Greatest heat felt, say	+	150	=	754·0	=	752
Alcohol boils	+	174	=	849·2	=	848
Water boils	+	212	=	1000·0	=	1000
Mercury boils	+	655	=	2758·0	=	2772
	+	672	=	2825·4	=	2849

In a small tract printed ten years ago, I showed that the idea of an absolute zero of cold expressible by a thermometer (Library of Useful Knowledge, *Heat*, ch. viii.) involved some fallacy. Fill a cylindrical tube with a heat-dilatable fluid, *e. g.* air, and continuing the divisions to each end of the tube, we should find that as air expands $\frac{1}{490}$th in volume per de-

* From the London, Edinburg, and Dublin Philosophical Magazine, for January, 1850.

gree from 32° Fahr. to 212° Fahr., the bottom of the tube would have $-480+32=-448°$ Fahr. marked on it. Fill such a tube with mercury, which expands $\frac{1}{9990}$th per degree betwixt the same extremes, and the bottom of the tube will indicate —9958° Fahr. Now could the substance ever contract to the bottom of the tube, its density must become infinitely great, as it then forms an infinitesimally thin stratum. May it therefore not be concluded that every substance has its own minimum temperature for maximum density, above or below which it expands just as water on each side of 39° Fahr.; the latter fluid having the lion's share of this peculiarity, just as magnetism is ordinarily visible in iron above all other metals, resembling in some sort the elective affinity so common in chemical combinations?

London, December 6, 1849.

For the Journal of the Franklin Institute.

Launch of three Steamers.

On Monday, the 28th of January, there was launched from the yard of William H. Brown, in New York, at the same time, three steamers, the "New World," the "Boston," and the "Artic." The "New World" had all her machinery up and steam on, and as soon as she was fairly in the water her engine was put in motion, and she made an excursion about the harbor, and sailed for California about two weeks after. She was 216 feet long, 27 feet beam, and had a single engine, with cylinders 40 inches diameter and 11 feet stroke. She may be called a semi sea steamer, being a compound of the ordinary sea steamer and our river boats. She will, no doubt, make a quick trip around.

The "Boston" was about 750 tons, and the "Artic" was one of the Collins line of Liverpool steamers, and the third launched. She is over 3000 tons burthen, and is to have side wheels and two side lever engines, with cylinders 95 inches diameter, and 10 feet stroke. X.

For the Journal of the Franklin Institute.

United States Naval Dry Docks.

At the present time, our Government have in progress four different dry docks, capable of docking the largest vessel afloat. These docks, from their great size and the many improvements that have been introduced, are far superior to any at present in use in Europe, and are such as to merit the attention of the readers of the Journal.

Of the four now building one is at Philadelphia, and is known as the floating *sectional* dry dock. It is patented by Messrs. Dakin, Moody, Burgess & Dodge, who are at present constructing this one for the Government, a considerable portion of which is already completed, and the balance in progress. When finished, this dock will consist of 10 sections, each of which has the capacity to raise 800 tons—total power 8000 tons—and will take up a vessel of 350 feet in length. Six sections will raise a ship of the line, and the four remaining sections will raise a frigate. The sec-

tions are placed side by side, and connected by timbers at the top of the tanks. The pumps for exhausting the sections are worked by four steam engines,—two of 20 and two of 12-horse power. One of each size is used on each side of the dock, and placed so that the two 20-horse engines exhaust 6 sections, and the two 12-horse engines exhaust 4 sections, a perfect uniformity of level being maintained by suitable connexions.

In connexion with the dock, there is a large stone basin, the sides and bottom being of granite. This basin is 350 feet long and 226 feet wide, and contains a sufficient depth of water, at ordinary high tide, to float the dock and the vessel it may contain.

Immediately adjacent to, and connected with, the basin, are two railways on the main land. These railways are to be of the most substantial character, and fully capable of sustaining any vessel the dock will raise.

The operation of the whole is as follows: The sections of the dock are hauled out into the river, and water let into them until they sink deep enough to allow the vessel to be floated in. As soon as this takes place, and the vessel is properly secured, the water is pumped out of the sections, and the vessel raised out of the water. When this has been accomplished, the whole is floated into the stone basin and allowed to ground on the bottom, when the vessel may be hauled on the railway. This is effected by means of a hydraulic cylinder, of 36 inches diameter and 12 feet stroke, worked by an engine of 40-horse power. If necessary, two vessels may be put on the railways, and a ship of the line and frigate left on the dock, so that the capacity of the dock is equal to four vessels of large class. When required, additional ways may be put up in connexion with the basin. The whole will be completed during 1851, but some of the sections will be ready this season. B.

For the Journal of the Franklin Institute.

An Account of the Explosion of a Steam Boiler in Hague St., New York.

This boiler, which exploded on the morning of the 4th of February, was in form what is termed "Montgomery's Patent." It was built in 1847 for Mr. Taylor, but, in consequence of some trouble between him and the builders, (Milligan & Walker,) he then refused to take it, and it was sold by them, to be used in a steamboat at Savannah; but the boiler proving too small, it was sent to Pease & Murphy, in New York, to be sold. While in their possession it was kept in the open air, but was well painted externally, and could have been injured but little. Mr. Taylor recently purchased the boiler from them to use in his machine shop; it was put up in the cellar of his premises, and was first used on Tuesday, the 29th of January, six days previous to the explosion. On using it the first day, with a pressure of 80 lbs. of steam, a loud report was heard, and, on, examination, water was found to be running freely out of the boiler from the inverted arch, and the brace A was found to have parted. They were obliged to haul the fire, let out the water, and remove a part of the broken brace that was attached to the tube sheet,—cut out the rivets, and then fill the holes with bolts; but no attempt was made to replace the brace.

After putting in the bolts and caulking the crown of the inverted arch, the boiler was again filled with water and steam raised; and, although they were aware that the boiler was not strong enough for 80 lbs. pressure, yet being behind with their work, and having to run during the night, Mr. Ford, the foreman of the establishment, moved out the weight on the safety valve lever to 90 lbs.; but before the steam blew off at that point, another loud report was heard, and the boiler found to be leaking badly. Mr. George Birkbeck, Jr., an engineer in business in New York, was then called upon to repair it. Mr. B. reports that, on examining the boiler, he found a fracture across the ends of the legs under the bridge-wall, at the points marked B and C, at which place, and also in the crown of the inverted arch, the boiler had leaked badly,—so bad that, on his arrival, the water had entirely leaked out. Patches were put on over the fractures at B and C in the legs, and the crown of the inverted arch was again recaulked. Mr. Taylor was then informed by Mr. Birkbeck that the boiler was not sufficiently strong to sustain the pressure of steam that they were using, and that, in his opinion, the working pressure should not exceed 50 lbs. under any circumstances. Yet, notwithstanding all these symptoms of weakness, and the opinion of one well acquainted with such matters, the usual pressure of steam (90 to 100 lbs.) appears to have been carried during the remainder of the week.

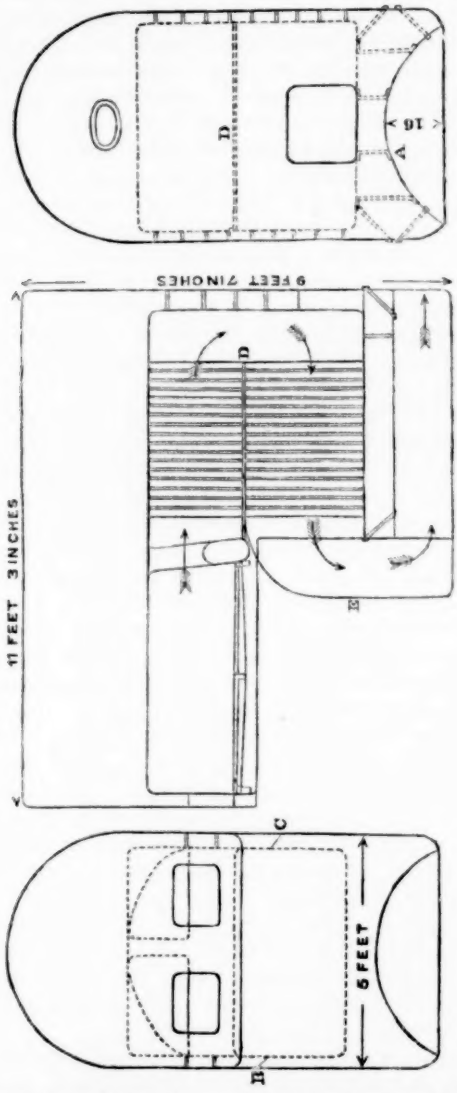
On Sunday the engineer, for the purpose of stopping the leaks in the boiler, put in it a quantity of horse manure and paper pulp,—articles which are sometimes used for that purpose. On Monday, (the day of the explosion,) the engineer appears to have been in the building as early as usual, but, from the testimony of the watchman on the premises, he did not succeed in starting his fire, and called upon him to assist him. In consequence of this delay, steam was not raised sufficiently by 7 o'clock, (the hour for commencing work,) and from the testimony of Mr. Brown, the chief smith of the establishment, we learn that his attention was called to the boiler by a peculiar smell emitted from it, as if the gaskets were burning;—that on trying the water gauge, (one of Worthington's percussion,) he could not find water, and that he then lifted the safety valve lever, when the steam that escaped, to use his own expression, "looked blue," which, being different from what he had often before observed, caused him to speak to the engineer about it, who told him to mind his own business. This was but three or four minutes previous to the explosion. The impression was so strong on his mind that something was wrong, that he was about leaving the building at the time of the explosion, and, by jumping, saved himself from the ruins.

The testimony given at the Coroner's Inquest, in relation to all the points here stated, is direct and positive. All testify that the boiler was not suitable for the pressure carried upon it; but Mr. Taylor himself says he used it the two days previous to the explosion with 100 lbs. of steam, and that he considered it safe at that pressure.

Having collected all the information I could get from authentic sources upon the subject, and having visited the premises and examined the various parts of the boiler, I am of the opinion that the boiler was entirely too weak for the pressure of steam that it was expected to sustain. It is hardly necessary, in support of this, to give anything more than the testimony

that has been referred to; but, on examining the crown of the inverted arch, it will be seen that, for a distance of 3½ feet in length, by the same in width, there was not a single brace,—a piece of gross negligence, and inexcusable in any one professing to manufacture boilers for practical use.

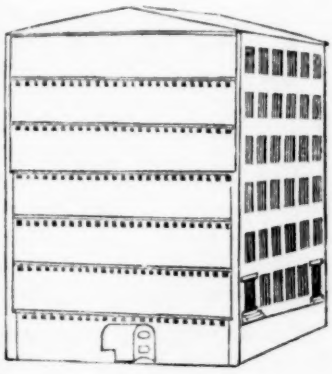
Fig. 1.



All the symptoms of weakness shown in the boiler previous to the explosion were in that part. But, notwithstanding this, I think the immediate cause of the explosion was owing to a short supply of water. I am led

to this conclusion from the testimony of Brown, and from the fact that the explosion occurred immediately after starting the engine,—a result which has been demonstrated, from experiment and practice, to be intimately connected with low water. Explosions that take place when there is an abundant supply of water, generally occur while there is no steam being drawn from the boiler, or in cases where the supply of steam exceeds the amount taken away. If we take a boiler with a full supply of water, and secure the safety valve so that it shall raise just previous to the steam reaching that point that will explode the boiler, the raising of the valve will relieve the pressure, and the boiler will be saved; but if we take the same boiler with a short supply of water, and safety valve secured as before, the raising of the valve, by causing the water to rise on the overheated iron, will to a certainty cause an explosion. I therefore assume that, in the absence of positive evidence to the contrary, all explosions that take place at the starting of the engine are caused by the absence of the proper supply of water.

This boiler was 11 feet 3 inches long, 5 feet wide, and 9 feet 7 inches high at the back end; it contained 289 vertical tubes, 4 feet 10 inches long, 2 inches outside diameter. The plate D has as many holes through it as there are tubes, and is secured in its place when the boiler is built. By the use of this plate, the flame is caused to pass between the tubes at their upper end, near the surface of the water, and to return to the front below near the bottom; it then returns to the back end again under what has been termed the inverted arch. The casing E is of sheet iron. The socket bolts in the legs of the boiler were screwed in, and slightly riveted over. The thickness of the shell and furnace was full $\frac{1}{4}$ inch. The safety valve was $2\frac{1}{2}$ inches diameter, and, with the weight at the outer notch, indicated 112 lbs.



The annexed diagram is an approximate one to the building occupied by A. B. Taylor & Co. Front of building about 50 feet, depth about 75 feet; 6 stories high; walls 18 inches thick to the third story, and above that 12 inches. The boiler and engine were in the cellar. The building was situated between other brick buildings, and in contact with them, but its walls were independent. The whole building was destroyed by the explosion, being lifted from its foundation and falling in one mass of ruins, burying 120 persons who were employed in it. Of that number 70 were killed, and nearly all the rest much injured. An explosion so disastrous in its consequences has never before taken place in this country, and it is incumbent on the authorities of each State that they require all boilers on land to be annually inspected, and prohibit the placing of them inside of large buildings. By this means something will be gained, and the loss of life be materially diminished.

The only portion of the boiler that retains its original shape is the tube

box and tubes,—these are comparatively uninjured, while all the rest is torn to pieces. The inverted arch has not yet been found, but it was separated completely from the rest of the boiler. The shell was divided in two pieces and flattened out; the separation took place midway in the length of the boiler, in line with the water bridge wall, and one piece, as found, was composed of the sides of the boiler that extended down to the inverted arch, (the socket bolts which held it to the tube box were all torn out,) and the portion of the crown above it. The other piece was composed of the crown and sides of the boiler, over and at the sides of the furnace; and also the entire sides and top of the furnace, which were separated lengthwise, as marked at *a;* the socket bolts were torn out, and the whole forms one large flat sheet. The entire front end of the boiler, with the front of the furnace and furnace door, was blown off in one piece; the back end is still attached to the tube box by the socket bolts, but is very much injured. The safety valve was blown off, taking with it a round piece of the shell of the same diameter as its flanch;—when found it was but little injured, and the weight was secured, (by means of a rope inside of it,) so that it could not have been inside the last notch, or not less than 112 lbs., leaving $1\frac{1}{2}$ inches of lever outside; if the weight was at the extreme end, then it would retain a pressure of 120 lbs.

The character of vertical tubular boilers is in nowise affected by this explosion. When duly proportioned they will be found economical, and must come into use where economy of fuel and space is an object. B.

For the Journal of the Franklin Institute.

Experiments on Paddle Wheels for Marine Steamers.

For the purpose of testing a new form of paddle for marine steamers, E. K. Collins, Esq., of New York, has had them applied to the wheels of the steamer "Penobscot," now running between Philadelphia and New York by sea. The paddles are of iron, $\frac{3}{8}$ in. thick, curved to the annexed sketch, the concave part striking the water. The result of the experiments will no doubt be made public.

On the Direct Production of Heat by Magnetism. *By* W. R. Grove, Esq.*

The author recites the experiments of Marrain, Beatson, Wertheim, and De la Rive, on the phenomenon made known some years ago, that soft iron, when magnetized, emitted a sound or musical note. He also mentions an experiment of his own, where a tube was filled with the liquid in which magnetic oxide had been prepared, and surrounded by a coil; this showed to a spectator looking through it an increase of the transmitted light when the coil was electrified. All these experiments, the author considers, go to prove that, whenever magnetization takes place, a change is produced

* From the London Athenæum, for June, 1849.

in the molecular condition of the substances magnetized; and it occurred to him that, if this be the case, a species of molecular friction might be expected to obtain, and by such molecular friction heat might be produced. In proving the correctness of these conjectures difficulties presented themselves, the principal of which was that, with electro-magnets, the heat produced by the electrized coil surrounding them might be expected to mask any heat developed by the magnetism. This interference the author considers he eliminated by surrounding the poles of an electro-magnet with cisterns of water, and by this means, and by covering the keeper with flannel, and other expedients, he was enabled to produce in a cylindrical soft iron keeper, when rapidly magnetized and demagnetized, a rise of temperature several degrees beyond that which obtained in the electro-magnet, and which, therefore, could not have been due to conduction or radiation of heat from such magnet. By filling the cisterns with water colder than the electro-magnet, the latter could be cooled while the keeper was being heated by the magnetization.

The author subsequently obtained distinct thermic effects in a bar of soft iron placed opposite to a rotating permanent steel magnet. To eliminate the effects of magnetico-electrical currents, the author then made experiments with non-magnetic metals, and with silico-borate of lead, substituted for the iron keepers, but no thermic effects were developed. He then tried the magnetic metals nickel and cobalt, and obtained thermic effects with both, and in proportion to their magnetic intensity.

Some questions of theory relating to the rationale of the action of what are termed "the imponderables," and to terrestrial magnetism, were then discussed, and the author concluded by stating that he considers that his experiments prove that, whenever a bar of iron or other magnetic metal is magnetized, its temperature is raised.—*Proc. Roy. Soc.*

For the Journal of the Franklin Institute.

Fresh Water in Marine Boilers.

"Z." is informed that such a condenser as he alludes to is now in progress of erection, by Merrick & Son, of this city, on board the steamer "Osprey." It is the invention of a Mr. Pirsson, of New York. The distinguishing feature between it and all others that have been used for the same purpose, is that, in this, the tubes have a vacuum outside as well as in them, and therefore are not liable to leak. B.

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*Protection of Iron from Oxidation.**

At the Exposition at Paris, in 1849, there were exhibited numerous articles manufactured in iron, covered with a kind of transparent vitreous coating, completely spread over the surface of the metal like a varnish, and capable of affording a perfect protection against the action of the air, or any other oxidizing agent. This appears to be an invention susceptible of many useful applications; for, whether the iron be in the state of a rolled

* From the London Civil Engineer and Architect's Journal, for February, 1850.

plate or bar, or drawn into tubes; whether it be cast into water pipes or into articles of the most elaborate form and design, as vases and other ornamental works, it can be equally well endowed with this protective coating;—it is also a matter of indifference whether the article be made of forge or cast iron.

The following is stated to be the process employed in imparting to the iron the vitreous surface:—Firstly, the object, whatever its shape may be, is thoroughly cleansed by dilute acid, which serves to remove from the metallic surface, grease, dirt, and every trace of oxide; this is important, for, if any foreign matter remain upon the surface, the perfect adherence of the fused glass will be effectually prevented, when that part of the operation is reached. After the action of the dilute acid, the work is to be well washed and then dried; when perfectly dry, it must be brushed over with a tolerably strong solution of gum arabic, which may be applied by means of a camel-hair brush. Over the whole extent of the gummed surface powdered glass, of a peculiar kind, is then sifted, and care must be taken to cover every part of the surface with this powder, otherwise the vitreous coating will be imperfect when the operations are completed.

When thus prepared, the work is introduced into a furnace or retort, heated to 100° or 150° centigrade (212° to 302° F.); and, when thoroughly dry, it is removed to another furnace, where it is brought to a cherry-red heat; the vitreous matter which adhered to the gummed surface of the metal now undergoes fusion;—the progress of this stage of the process is ascertained by looking through a small opening (contrived for the purpose) in the heated chamber. When the fusion is complete, and the glass seems to have flowed over the whole surface, the article is removed from the furnace and placed in a close chamber, from which the air is entirely excluded—here it is kept until it has cooled down to the temperature of the atmosphere.

The vitreous compound applied to the surface of the metal consists of the following substances:—Powdered flint glass, 130 parts; carbonate of soda, 20½ parts; boracic acid, 12 parts. These must be melted together in a "glass pot," and a fusible glass will be the result; when cold, this must be pounded with care, so that it may be reduced to a powder sufficiently fine to pass through a silk sieve. When thus prepared, it is ready to be applied to the surface of the iron, according to the method described above. If, after the first process, the coating of vitrified matter on the metal should prove not to be quite perfect, the manipulation must be repeated, a second coat of powdered glass being applied in the same manner as the first. It is necessary that the vitreous matter which forms the coating should be free from foreign matter, for if the object to be coated be oxidized or greasy, the coating of glass will not adhere, and the result of the operation will be, consequently, very imperfect.

On the Diffusion of Liquids. *By* Prof. Graham.*

The characters of liquid diffusion were first examined in detail with reference to common salt. It was found, first, that, with solutions containing

* From the London Athenæum, for January, 1850.

1, 2, 3, and 4 per cent., the quantities of salt which diffused out of an open phial of 1·25 inch aperture, properly filled, into the water of a large jar, in which the phial was entirely immersed, in a constant period of eight days, were as nearly in proportion to these numbers as 1, 1·99, 3·01, and 4·00; and that, in repetitions of the experiments, the results did not vary more than $\frac{1}{40}$ part. The proportion of salt which diffused out in such experiments amounted to about $\frac{1}{8}$ of the whole. Secondly, that the proportion of salt diffused increases with the temperature, an elevation of 80° F. doubling the quantity of chloride of sodium diffused in the same time.

The diffusibility of a variety of substances was next compared, a solution of 20 parts of the substance in 100 water being always used. Some of the results were as follows, the quantities diffused being expressed in grains: chloride of sodium 58·68, sulphate of magnesia 27·42, sulphate of water 69·32, crystallized cane sugar 26·74, starch sugar 26·94, gum arabic 13·24, albumen 3·03. The low diffusibility of albumen is very remarkable, and the value of this property in retaining the serous fluids within the blood vessels at once suggests itself. It was further observed that common salt, sugar, and urea, added to the albumen under diffusion, diffused away from the latter as readily as from their aqueous solutions. Urea itself is as highly diffusible as chloride of sodium.

In comparing the diffusion of salts dissolved in ten times their weight of water, it was found that isomorphous compounds generally had an equal diffusibility: chloride of potassium corresponding with chloride of ammonium, nitrate of potash with nitrate of ammonia, and sulphate of magnesia with sulphate of zinc. The most remarkable circumstance is, that these pairs are "equi-diffusive,"—not for chemically equivalent quantities, but for equal weights simply. The acids differed greatly in diffusibility, nitric acid being nearly four times more diffusive than phosphoric acid; but these substances also fell into groups,—nitric and hydrochloric acids appearing to be equally diffusive; so also acetic and sulphuric acids.

Soluble sub-salts and the ammoniated salts of the metals present a surprisingly low diffusibility. The quantities diffused in similar circumstances of the three salts, sulphate of ammonia, sulphate of copper, and the blue ammonio-sulphate of copper, being very nearly as 8, 4, and 1. When two salts are mixed in the solution cell, they diffuse out into the water atmosphere separately and independently of each other, according to their individual diffusibilities. This is quite analogous to what happens when mixed gases are diffused into air. An important consequence is, that in liquid diffusion we have a new method of separation or analysis for many soluble bodies, quite analogous in principle to the separation of unequally volatile substances in the process of distillation. Thus it was shown that chlorides diffuse out from sulphates and carbonates, and salts of potash from salts of soda; and that, from sea water, the salts of soda diffuse out into pure water faster than the salts of magnesia. The latter circumstance was applied to explain the discordant results which have been obtained by different chemists in the analysis of the water of the Dead Sea, taken near the surface;—the different salts diffusing up into the sheet of fresh water, with which the lake is periodically covered, with unequal velocity.

It was further shown that chemical decompositions may be produced by

liquid diffusion: the constituents of a double salt of so much stability as common alum being separated, and the sulphate of potash diffusing in the largest proportion. In fact, the diffusive force is one of great energy, and quite as capable of breaking up compounds as the unequal volatility of their constituents. Many empirical operations in the chemical arts, it was said, have their foundation in such decompositions. Again, one salt, such as nitrate of potash, will diffuse into a solution of another salt, such as nitrate of ammonia, as rapidly as into pure water,—the salts appearing mutually diffusible, as gases are known to be. Lastly, the diffusibilities of the salts into water, like those of the gases into air, appear to be connected by simple numerical relations.

These relations are best observed when dilute solutions of the salts are diffused from the solution cell, such as 4, 2, or even 1 per cent. of salt. The quantities diffused in the same time from 4 per cent. solutions of the three salts, carbonate of potash, sulphate of potash, and sulphate of ammonia, were 10·25 grains, 10·57 grains, and 10·71 grains, respectively, and a similar approach to equality was observed in the 1, 2, and $6\frac{2}{3}$ per cent. solutions of the same salts. It also held at different temperatures. The acetate of potash appeared to coincide in diffusibility with the same group, and so did the ferrocyanide of potassium. The nitrate of potash, chlorate of potash, nitrate of ammonia, chloride of potassium, and chloride of ammonium formed another equi-diffusive group.

The *times* in which an equal amount of diffusion took place in these two groups appeared to be as 1 for the second to 1·4142 for the first, or as 1 to the square root of 2. Now, in gases the *squares of the times* of equal diffusion are the *densities of the gases*. The relation between the sulphate of potash and nitrate of potash groups would, therefore, fall to be referred to the diffusion molecule and diffusion vapor of the first group having a density represented by 2, while that of the second group is represented by 1. These were named the *solution densities* of the salts in question. The corresponding salts of soda appeared to fall into a nitrate and sulphate groups also, which have the same relation to each other as the potash salts. The relation of the salts of potash to those of soda, in times of equal diffusibility, appeared to be as the square root of 2 to the square root of 3; which gives to them solution densities of 2 and 3. Hydrate of potash and sulphate of magnesia were less fully examined; but the first presented sensibly double the diffusibility of sulphate of potash, and four times the diffusibility of the sulphate of magnesia.

If these times are all squared, the following remarkable ratios are obtained for the solution densities of these different salts, each of which is the type of a class of salts: hydrate of potash 1, nitrate of potash 2, sulphate of potash 4, sulphate of magnesia 16, with nitrate of soda 3, and sulphate of soda 6. In conclusion, it was observed that it is the diffusion molecules of the salts, having such densities, which are concerned in solubility, and not the Daltonian atoms or equivalents of chemical combination; and the application was indicated of a knowledge of the diffusibilities of different substances to the study of endosmose, in which the proper function of the membrane would be distinguished from that of the salt.—*Proc. Roy. Soc.*

For the Journal of the Franklin Institute.

Economy of the Steam Engine.

In the last number of the Journal I stated the causes of loss, which were, first, insufficiency of power produced, by having an engine too small for the work to be done, or boilers too small for the engine, or from both these causes combined.

The great loss that ensues in this city from the use of too small an engine can hardly be estimated. Those who use them appear not to be aware of the advantages of using steam expansively; and as, in fitting up their works, first cost instead of economy of fuel has been the principal object kept in view, they go into operation with an engine much below the size required, and with boilers just sufficient to supply it with steam; and go on working steam full stroke, with their fires constantly agitated to make a sufficient supply. If they would double the size of the engine, the same steam, used expansively, would do much more work, or the same work could be done with three-fourths of the fuel; and if, in addition to this, they will add 50 per cent. to their boilers, an additional saving will be made. Two instances have occurred to my knowledge within the last twelve months where a great saving has been made; the first engine had three plain cylinder boilers, 30 in. diameter and 26 ft. long. They were taken out, and three of the same diameter and 36 ft. long used. With the first set of boilers, the fires required a good deal of attention to make steam; the second set makes steam freely with two-thirds of the fuel;—no change was made in the engine. In the second case, the engine had four 30-inch boilers, 22 feet long; four 30-inch boilers, 40 feet long, were put in their place, and a cut-off valve applied to the engine. The consumption of fuel was reduced from $5\frac{1}{2}$ tons in 24 hours to $3\frac{1}{4}$ tons, and does nearly 10 per cent. more work. I will consider the other items of loss in your next.

W.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, February 21st, 1850.

Samuel V. Merrick, President, in the chair.

Thomas Fletcher, Vice President.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Donations were received from the Royal Irish Academy, Dublin; Wm. Jackson, Esq., Boston, Mass.; Wm. M. Wadly, Esq., Savannah, Ga.; the Young Men's Library Association, Cincinnati, Ohio; Thos. H. Forsyth, Esq. and Wm. H. Souder, Esq., Pennsylvania Legislature; Hon. Jos. R. Chandler, U. S. Congress; Charles E. Smith, Esq., A. B. Hutton, Esq., Dr. Wm. Pettit, Solomon W. Roberts, Esq., Major Hartman Bache, M. W. Baldwin, Esq., The Library Company of Philadelphia, and Prof. Jno. F. Frazer, Philadelphia.

The periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of receipts and payments for the month of January.

The Board of Managers and the Standing Committees reported their minutes.

New candidates for membership in the Institute (6) were proposed, and those proposed at the last meeting (12) were elected members of the Institute.

The Standing Committees for the ensuing year were nominated and appointed as follows:

Library.

John Allen,
Dr. S. S Brooks,
George Harding,
William S. Levering,
B. V. Marsh,
Daniel Rhoads,
William Roberts,
Jacob D. Sheble,
Charles E. Smith,
Dr. G. J. Zeigler.

Exhibitions.

John Agnew,
John E. Addicks,
John C. Cresson,
Owen Evans,
James P. Ellis,
Thomas Fletcher,
William D. Parrish,
John Wiegand,
C. A. Walborn,
Alan Wood.

Cabinet of Minerals and Geological Specimens.

James C. Booth,
Dr. M. H. Boyé,
John F. Frazer,
William P. Foulke,
Edwin Greble,
Dr. B. H. Rand,
R. C. Taylor,
A. W. Thompson,
Dr. L. Turnbull,
Dr. C. Wetherill.

Cabinet of Arts and Manufactures.

James C. Booth,
J. C. Copper,
James Euston,
C. M. Ghrisky,
William Harris,
Dr. A. L. Kennedy,
William P. Troth,
G. L. Thomas,
Isaac S. Williams,
T. J. Weygandt.

Meteorology.

Samuel W. Black.
M. T. W. Chandler,
Emlen Cresson,
Dr. Charles M. Cresson,
Owen Evans,
James P. Ellis,
Dr. G. Emerson,
James S. Lippincott,
John Simmons,
Beaton Smith.

Meetings.

George Ashmead,
Joseph M. Cardeza,
B. B. Gumpert,
Dr. Henry Gibbons,
Dr. B. H. Rand,
George W. Smith,
Return Sheble,
James Swaim,
Dr. L. Turnbull,
R. A. Tilghman.

Cabinet of Models.

John Agnew,
A. L. Archambault,
H. P. M. Birkinbine,
J. J. Barras,
B. M. Feltwell,
Henry Huber, Jr.,
J. Vaughan Merrick,
Thomas S. Stewart,
Thomas U. Walter,
Thomas F. Williams.

Mr. Phleger explained the construction of a very powerful pump, used by the Corporation of the City, in relieving from water the excavation in progress in Walnut street, for the tunnel.

A specimen of Marble, with very large crystals, of great purity and whiteness of color, from the quarries 14 miles from the Baltimore and York Railroad, was exhibited.

Dr. Turnbull exhibited to the meeting specimens of the beautiful Red Zinc Ore of New Jersey, with the result of the most recent analysis, by Berthier, of a pure crystallized specimen, which contained 88 per cent. of oxide of zinc, and 12 of the red oxide of manganese. Some of this ore also contains iron, as it occurs with franklinite and calc spar at Franklin and Sterling, in New Jersey. Iron and manganese generally accompany it, and interfere effectually with its reduction into metallic zinc on a large scale.

He also exhibited specimens of the Oxide of Zinc, or Zinc Paint, which he remarked was known to the ancients as early as the time of Dioscorides. The first notice of a substitute for lead is found in the Elements of Chemistry of M. T. A. Chaptal, translated from the French by W. Nicholson, in April, 1791. At page 323, he remarks that M. De Morveau has substituted the precipitate of zinc for white lead with the greatest advantage. It answers perfectly the intention of the artist, and is not attended with any dangerous consequences in its use.

In the Elements of Chemistry of Andrew Fyfe, published in 1827, he says that the oxide of zinc is sometimes employed by painters, instead of white lead, in the preparation of their paint. Although it is more troublesome to work with, in other respects it is preferrable to white lead, not being liable to become dark colored, nor does it prove injurious to the workmen.

It will be seen from the above quotations, that this is an old subject again brought forward very prominently by Mr. Leclaire, a house painter of Paris, who has received the decoration of the Legion of Honor from the French Government. Its practical importance, both as regards public health and the use of an article so abundant, are the causes of bringing the subject before the Institute.

All the specimens of oxide of zinc prepared by precipitation and sublimation are unsatisfactory, being all inferior in color, and in the power of covering surfaces. Dr. T. exhibited two specimens upon wood and glass, remarking that one coat of pure lead in oil was fully equal to two of zinc. He also showed some carbonate, which is much whiter, and it has been suggested that the French method may be the same as that employed for white lead. He has, therefore, deputized a friend to bring several specimens from Paris, and obtain the requisite information in regard to its mode of preparation, which he will bring before the Institute on a future occasion.

Specimens of native Copper, from the north-west mines, Lake Superior, were exhibited. The Copper is of sufficient purity to allow of rolling without being previously smelted. A long and exceedingly thin ribbon, thus prepared, was presented for examination.

Mr. Smith, the Chairman of the Committee, exhibited a specimen of Faber's Magnetic Steam Gauge. The construction is as follows: A ball,